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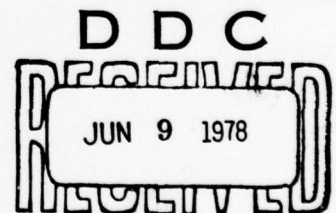   FOR FURTHER TRAN

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ANALYSIS OF MOBILITY DATA FROM
THE DIVISION RESTRUCTURING EVALUATION
BATTALION TEST

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Technical Paper TP 2-78	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Analysis of Mobility Data from the Division Restructuring Evaluation Battalion Test.		5. TYPE OF REPORT & PERIOD COVERED Final Report.
		6. PERFORMING ORG. REPORT NUMBER CACDA-TP-2-78
7. AUTHOR(s) Rudolph J. Pabon Royce S. Hamlin Robert A. Martray		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Combined Arms Combat Developments Activity Combat Operations Analysis Directorate ATTN: ATCA-CAT-D, Ft Leavenworth, KS 66027		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS ACN 39307
11. CONTROLLING OFFICE NAME AND ADDRESS Same as above		12. REPORT DATE April 1978
		13. NUMBER OF PAGES 153 148 p.
14. MONITORING AGENCY NAME & ADDRESS(If different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Division Restructuring Evaluation, current and restructured maneuver battalions, slope class, vegetation/trafficability category, movement to contact, active defense, deliberate attack, mobility rate.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The battalion test was a field exercise of the proposed tank and mechanized infantry T-series battalions and the current H-series battalions. The TRADOC Combined Arms Testing Agency (TCATA) conducted the test and authored the test report, which entails in depth side-by-side comparisons of the alternative organizations with respect to fire and maneuverability, combat support, combat service support, and command/control and communications. This paper describes the data reduction/analysis performed on the Division Restructuring Evaluation-Battalion test data. These data were limited to information concerning maneuver operations for selected instrumented

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20. ABSTRACT (Continued)
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Directorate of Combat Operations Analysis
US Army Combined Arms Combat Developments Activity
Fort Leavenworth, Kansas 66027

ANALYSIS OF MOBILITY DATA FROM THE

DIVISION RESTRUCTURING EVALUATION

BATTALION TEST

by

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Royce S. Hamlin
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ACN 39307

FOREWORD

We would like to extend our appreciation to the following individuals for their contribution to the completion of this paper: Mr. J. Low, Mr. R. Davison, Miss S. Wright, Mr. W. Thomson, and MAJ R. Lenz. A special thanks to Mrs. R. Fulks whose patience and understanding finalized this paper into a well-typed document.

ABSTRACT

The battalion test was a field exercise of the proposed tank and mechanized infantry T-series battalions and the current H-series battalions. The TRADOC Combined Arms Testing Agency (TCATA) conducted the test and authored the test report, which entails in depth side-by-side comparisons of the alternative organizations with respect to fire and maneuverability, combat support, combat service support, and command/control and communications.

This paper describes the data reduction/analysis performed on the Division Restructuring Evaluation-Battalion test data. These data were limited to information concerning maneuver operations for selected instrumented units and command/control information for instrumented/non-instrumented units of the respective organizations. The data analysis results were provided as input to the CACDA CARMONETTE modeling effort in support of the Division Restructuring Evaluation.

EXECUTIVE SUMMARY

1. BACKGROUND.

    a. Weapon systems and their best mode of employment are the driving rationale for the structuring of the T-series maneuver battalions. Weapons are grouped in company organizations; e.g., tanks (tank companies); dedicated TOW (TOW companies); and mechanized infantry, infantry fighting vehicles, and DRAGON (rifle companies). These maneuver battalions are smaller and should have tighter command and control relationships. The tank battalion of three 11-tank tank companies (three tank platoons, three tanks each) should be more agile and responsive and should generate a greater percentage of available combat power. With tighter command and control, weapon systems should be able to move more quickly into, out of, and between positions; and in general, be more responsive in a changing combat environment.

    b. The US Army Training and Doctrine Command conducted the first phase of the Division Restructuring Study in response to a request from the Chief of Staff, US Army, through the DCSOPS in March of 1975 that ". . . .we. . . . closely monitor the development of structure and that our missions, doctrine, and organizational concepts are in concert. . . ." and ". . . .that an identifiable study be initiated to answer these and other questions concerning our division structure. . . ." In accordance with that guidance, TRADOC initiated a Division Structure Analysis, which later evolved into the present Division Restructuring Evaluation (DRE) study. This study was designed to encompass a number of independent tests/studies, but the major thrust of the DRE study is the battalion and division (-) level field tests.

    c. The battalion test phase is the only field exercise that provides side-by-side comparison testing between restructured maneuver (T-series TOE) and current (H-series TOE) battalions. Units participating in this test consisted of two T-series tank battalions, two H-series tank battalions, two T-series mechanized infantry battalions, and two H-series mechanized infantry battalions.

        (1) The battalion test, Phase I, was a two-sided, partially instrumented test, which permitted both instrumented and noninstrumented systems to interact in a realistic battlefield situation. The mechanized infantry participated as a noninstrumented (except for TOWs) system capable of realistically influencing the outcome of the battle. Trials were conducted from 16 October through 31 October 1977 and 2 December through 17 December 1977.

        (2) The exercise was conducted on the Fort Hood reservation bounded on the north by the reservation boundary, the east by West Range Road, the south by Old Copperas Cove Road, and the west by the reservation boundary. This area of the reservation is characterized by open rolling hills in the south with one major stream, House Creek. The center of the sector is

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dominated by Cowhouse Creek and the northern sector is characterized by mountainous terrain, which is heavily wooded in sections.

2. PURPOSE. The battalion level field exercise was designed to provide test data to support appropriate simulation, analysis, and evaluation of the combat effectiveness of the proposed restructured maneuver battalions.

3. OBJECTIVES.

   a. <u>Objective 1</u>. Provide data on the fire and maneuver capabilities of the current and proposed maneuver battalions.

   b. <u>Objective 2</u>. Provide data on the capabilities and organization for combat support of the current and proposed maneuver battalions.

   c. <u>Objective 3</u>. Provide data on the capabilities and organization for combat service support of the current and proposed maneuver battalions.

   d. <u>Objective 4</u>. Provide data on command, control, and communications aspects of the current and proposed maneuver battalions.

   e. <u>Objective 5</u>. Identify training implications emerging from reorganization of proposed maneuver battalions (to be addressed by a separate plan).

4. SCOPE.

   a. The SCORES Europe I scenario was used as a guide in structuring the test trials. The test, using four player battalions at a time, followed a round-robin scheme where one battalion was the test unit and the remaining three battalions constituted the opposing force. Upon completion of a trial a new test battalion came from the opposing force and the old test battalion rejoined the opposing force. This rotation continued until all four battalions had completed a trial as the test unit. When the first four battalions completed testing, they were replaced by the remaining four battalions and the same scheme was followed.

   b. Each trial consisted of three operations: defense, offense, and assembly area/tactical road march. The defense, with a planned opposing force to friendly force ratio of 1.95:1 to 2.2:1, was further divided into two events: day defense and night defense. The offense, with a planned force ratio of 1:3, enemy to friendly, was divided into movement to contact and deliberate attack. Administrative breaks were scheduled during each trial to allow instrumentation checkout and appropriate constitution of force ratios.

   c. Tactics employed by the opposing force generally followed US doctrine (current and restructured as appropriate). This policy maximized the training benefit for all units participating. All test units underwent training to include completion of the appropriate battalion Army Training and Evaluation Program (ARTEP) prior to the test.

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d. Weapon systems that were instrumented with the TCATA Automated Field Instrumentation System (TAFIS) were the M60 tank main gun and the TOW antitank guided missile mounted on an M113. Additionally, the Fire Integration Support Team (FIST) vehicles, with the tested T-series tank battalion task force, and the headquarters tank sections were instrumented as target vehicles only. This limitation was due to the number of instrumentation systems available. A detailed system, developed by TCATA, for the play of noninstrumented systems was used in an attempt to provide sufficient realism and effect on maneuver; however, this system was not designed to assess casualties.

5. ANALYSIS RESULTS.

a. The H-series organization (tank and TOW weapon systems) had a faster mean mobility rate in 67 percent of the T- versus H-series pairwise comparisons. Nine percent of the comparisons proved the T-series weapon systems to have the faster mean mobility rate, with 24 percent of the comparisons showing no significant difference. Table 35, page 45, depicts the specific results of these pairwise comparisons.

b. Due to the paucity of the data, the command and control response times were not analyzed. Tables 30 and 31, pages 39 and 40, depict the mean response times for the alternative organizations.

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1. INTRODUCTION.

   a. Background. The concept for the restructured maneuver battalions is based on the following rationale and hypotheses.

      (1) Weapons systems and their best mode of employment are the driving rationale for the structuring of the maneuver battalions. Weapons are grouped in company organizations; e.g., tanks (tank companies); dedicated TOW (TOW companies); and mechanized infantry, infantry fighting vehicles, and DRAGON (rifle companies).

      (2) Maneuver battalions are smaller and should have tighter command and control relationships. The tank battalion of three 11-tank tank companies (three tank platoons, three tanks each) should be more agile and responsive and should generate a greater percentage of available combat power. Long range ATGM are assigned to a separate company within the battalion for better control and placement to complement the fire of the tank. The battalion is the primary level for integration of combined arms. The more experienced battalion commander, with the assistance of his staff and fire support coordinator, is better able to integrate and coordinate the fires of his organization than the company commander, as is the present practice. Cross attachment will be at battalion level, except for rare instances. Maneuver within tank companies will be the rule; tank platoons will not be expected to perform overwatch tactics within the platoon because of the size of the three tank platoons. Company commanders will fight their organization rather than remain back to manage and coordinate the mixed elements. Dedicated organization of weapons systems will insure that the proper weapons systems are fitted to the terrain where they are employed to their best advantage. With tighter command and control, weapons systems will be able to move more quickly into, out of, and between positions; and in general, be more responsive in a changing combat environment.

      (3) As a result, the US Army Training and Doctrine Command conducted the first phase of the Division Restructuring Study in response to a request from the Chief of Staff, US Army, through the DCSOPS in March of 1975 that ". . . .we. . . .closely monitor the development of structure and that our missions, doctrine, and organizational concepts are in concert. . . ." and. . . . "that an identifiable study be initiated to answer these and other questions concerning our division structure. . . ." In accordance with that guidance, TRADOC initiated a Division Structure Analysis, which later evolved into the present Division Restructuring Evaluation Study.

   b. Purpose. The battalion level field exercise was designed to provide test data to support appropriate simulation, analysis, and evaluation of the combat effectiveness of the proposed restructured maneuver battalions. Results will assist in the comparison of the current and candidate maneuver battalions.

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c. Objectives.

(1) Objective 1. Provide data on the fire and maneuver capabilities of the current and proposed maneuver battalions.

(2) Objective 2. Provide data on the capabilities and organization for combat support of the current and proposed maneuver battalions.

(3) Objective 3. Provide data on the capabilities and organization for combat service support of the current and proposed maneuver battalions.

(4) Objective 4. Provide data on command, control, and communications aspects of the current and proposed maneuver battalions.

(5) Objective 5. Identify training implications emerging from reorganization of proposed maneuver battalions (to be addressed by a separate plan).

d. Scope.

(1) The battalion test, Phase I, was a two-sided, partially instrumented test that permitted both instrumented and noninstrumented systems to interact in a realistic battlefield situation. It provided for integration of all supporting battlefield systems to include mine/countermine warfare, artillery, air defense, and indirect illumination. The mechanized infantry participated as a noninstrumented (except for TOWs) system capable of realistically influencing the outcome of the battle.

(2) The battalion test phase was a 6-week field test that included side-by-side comparison testing between restructured (T-series TOE) and current (H-series TOE) battalions. Units participating in this test consisted of two T-series tank battalions, two H-series tank battalions, two T-series mechanized infantry battalions, and two H-series mechanized infantry battalions.

(3) Units participating in this test were organized into task forces of two T-series tank battalions, two H-series tank battalions, two T-series mechanized infantry battalions, and two H-series mechanized infantry battalions.

(a) T-series tank battalion task force (two): two tank companies, one mechanized company, one TOW company, one headquarters and headquarters company, one combat service support company, and one maintenance company.

(b) T-series mechanized infantry battalion task force (two): two mechanized companies, one tank company, one TOW company, one headquarters and headquarters company, one combat service support company, and one maintenance company.

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(c) H-series tank battalion task force (two): two tank companies, one mechanized infantry company (reinforced with one TOW section), one headquarters and headquarters company, and one combat support company.

(d) H-series mechanized infantry battalion task force (two): two mechanized infantry companies, one tank company, one headquarters and headquarters company, one combat support company (minus one TOW section, attached to mechanized company attached to H-tank battalion).

(4) Each battalion, when tested, received an appropriate share of divisional combat and combat service support assets.

(5) Test issues pertaining to Scouts at battalion level were also addressed; consequently, the composition of Scouts varied for test units. Two configurations were used in the T-series battalions: light Scouts or heavy Scouts. (These issues are not addressed in this paper.)

(6) Direct support artillery and mortar employment and suppression were represented but are not examined in this paper. Engineer support was addressed to a limited extent but is not considered in this paper. Close air support and attack helicopter employment were planned and requested but were not actually performed, except for the administrative aspects.

e. Test Concept.

(1) The SCORES Europe I scenario was used as a guide in structuring the test trials. The test site was located at Fort Hood, Texas. Environmental and energy impacts of this test were not considered to be significant.

(2) The test, using four player battalions at a time, followed a round-robin scheme where one battalion was the test unit and the remaining three battalions constituted the opposing force. Upon completion of a trial, a new test battalion came from the opposing force and the old test battalion joined the opposing force. This rotation continued until all four battalions had completed a trial as the test unit. When the first four battalions completed testing, they were replaced by the remaining four battalions and the same scheme was followed.

(3) Each trial consisted of three operations: defense, offense, and assembly area/tactical road march. The defense, with a planned opposing force to friendly force ratio of 1.95:1 to 2.2:1, was further divided into two events: day defense and night defense. The offense, with a planned force ratio of 1:3, enemy to friendly, was divided into movement to contact and deliberate attack. (Appendix A describes these events.) Tables 1 through 4 depict the force composition/ratios for the battalion test.

(4) Tactics employed by the opposing force followed US doctrine (current and restructured as appropriate). This policy maximized the training benefits for all units participating.

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Table 1. Force composition/ratio requirements, trials 1-4 - defense

Trial	Test Unit	Threat		Friendly			Threat			T:F Ratio	Total Instr Systems
		T-Series	H-Series	TK	TOW	TOT	TK	TOW	TOT		
1	T-series tank TF 2 TK Co 1 Mech Co 1 TOW Co 1 Hvy Sct Sec	Mech Bn HQ 2 Mech Co 1 TOW Co	Mech Bn HQ TK Bn HQ 2 TK Co 3 Mech Co 1 Sct Plt 1 AT Plt(-)	22	15	37	42	30	72	1.95:1	109
2	H-series tank TF 2 TK Co 1 Mech Co 1 Sct Plt	Mech Bn HQ TK Bn HQ 3 TK Co 3 Mech Co 2 TOW Co 1 Hvy Sct Sec	Mech Bn HQ 2 Mech Co 1 TK Plt(+) 1 AT Plt(-)	34	6	40	39	39	78	1.95:1	118
3	T-series Mech TF 1 TK Co 2 Mech Co 1 TOW Co 1 Hvy Sct Sec	TK Bn HQ 2 TK Co 1 Mech Co 1 TOW Co	Mech Bn HQ TK Bn HQ 1 TK Co 3 Mech Co	11	15	26	39	18	57	2.2:1	83
4	H-series Mech TF 1 TK Co 2 Mech Co 1 AT Plt 1 Sct Plt	Mech Bn HQ TK Bn HQ 3 TK Co 3 Mech Co 1 TOW Co 1 TOW Co (-) 1 Hvy Sct Sec	TK Bn HQ 1 TK Co 1 TK Plt(+) 1 Mech Co(-)	17	20	37	56	25	81	2.2:1	118

NOTE: In addition to above, FIST vehicles and TK Bn HQ tanks instrumented for "be killed only."

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Table 2. Force composition/ratio requirements, trials 1-4 - attack

Trial	Test Unit	Threat		Friendly			Threat			F:T Ratio	Total Instr Systems
		T-Series	H-Series	TK	TOW	TOT	TK	TOW	TOT		
1	T-series Tank TF 2 TK Co 1 Mech Co 1 TOW Co 1 Hvy Sct Sec		1 TK Co HQ 1 TK Plt 1 Mech Plt 2 TOW Sec(+)	22	15	37	7	5	12	3.1:1	49
2	H-series Tank TF 2 TK Co 1 Mech Co 1 Sct Plt	1 TK Co 1 TOW Sec 1 Mech Plt		34	6	40	11	2	13	3.1:1	53
3	T-series Mech TF 1 TK Co 2 Mech Co 1 TOW Co 1 Hvy Sct Sec	1 Mech Co HQ 2 Mech Plt 1 TK Plt 1 TOW Plt(+)		11	15	26	3	6	9	2.9:1	35
4	H-series Mech TF 1 TK Co 2 Mech Co 1 AT Plt 1 Sct Plt		1 Mech Co HQ 2 Mech Plt 1 TK Plt 3 TOW Sec	17	20	37	5	8	13	2.85:1	51

NOTE: In addition to above, FIST vehicles and TK Bn HQ tanks instrumented for "be killed only."

Table 3. Force composition/ratio requirements, trials 5-8 - defense

Trial	Test Unit	Threat		Friendly			Threat			T:F Ratio	Total Instr Systems
		T-Series	H-Series	TK	TOW	TOT	TK	TOW	TOT		
5	H-series Tank TF 2 TK Co 1 Mech Co 1 Sct Plt	Mech Bn HQ TK Bn HQ 3 TK Co 3 Mech Co 2 TOW Co 1 Hvy Sct Sec	Mech Bn HQ 2 Mech Co 1 TK Plt(+) 1 AT Plt(-)	34	6	40	39	39	78	1.95:1	118
6	T-series Tank TF 2 TK Co 1 Mech Co 1 TOW Co 1 Lt Sct Sec	Mech Bn HQ 2 Mech Co 1 TOW Co	Mech Bn HQ TK Bn HQ 2 TK Co 3 Mech Co 1 Sct Plt 1 AT Plt(-)	22	12	34	42	30	72	2.1:1	105
7	H-series Mech TF 1 TK Co 2 Mech Co 1 AT Plt	Mech Bn HQ TK Bn HQ 3 TK Co 3 Mech Co 1 TOW Co(-) 1 Hvy Sct Sec	TK Bn HQ 1 TK Co 1 TK Plt(+) 1 Mech Co(-)	17	20	37	56	25	81	2.2:1	118
8	T-series Mech TF 1 TK Co 2 Mech Co 1 TOW Co 1 Lt Sct Sec	TK Bn HQ 2 TK Co 1 Mech Co 1 TOW Co	Mech Bn HQ TK Bn HQ 1 TK Co 3 Mech Co	11	12	23	39	18	57	2.5:1	80

NOTE: In addition to above, FIST vehicles and TK Bn HQ tanks instrumented for "be killed only."

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Table 4. Force composition/ratio requirements, trials 5-8 - attack

Trial	Test Unit	Threat		Friendly			Threat			F:T Ratio	Total Instr Systems
		T-Series	H-Series	TK	TOW	TOT	TK	TOW	TOT		
5	H-series Tank TF 2 TK Co 1 Mech Co 1 Sct Plt	1 TK Co 1 TOW Sec 1 Mech Plt		34	6	40	11	2	13	3.1:1	53
6	T-series Tank TF 2 TK Co 1 Mech Co 1 TOW Co 1 Lt Sct Sec		1 TK Co HQ 1 TK Plt 1 Mech Plt 2 TOW Sec(+)	22	12	34	7	5	12	2.85:1	46
7	H-series Mech TF 1 TK Co 2 Mech Co 1 AT Plt 1 Sct Plt		1 Mech Co HQ 2 Mech Plt 1 TK Plt 3 TOW Sec	17	20	37	5	8	13	2.85:1	51
8	T-series Mech TF 1 TK Co 2 Mech Co 1 TOW Co 1 Lt Sct Sec	1 Mech Co HQ 2 Mech Plt 1 TK Plt 1 TOW Plt(+)		11	12	23	3	6	9	2.75:1	32

NOTE: In addition to above, FIST vehicles and TK Bn HQ tanks instrumented for "be killed only."

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(5) Weapon systems that were instrumented were the M60 tank main gun and the TOW antitank guided missile mounted on an M113. Additionally, the Fire Integration System Team (FIST) vehicles, with the tested T-series tank battalion task force, and the headquarters tank sections were instrumented as target vehicles only. This limitation was due to the number of instrumentation systems available. A detailed system for the play of non-instrumented systems was used, which provided sufficient realism and effect on maneuver but did not assess casualties.

(6) Electronic warfare (jamming) was played at specified periods during the movement to contact events. The effects of jamming are not addressed in this paper.

(7) It was not possible to insure that 100 percent of the instrumentation was working prior to the start of an event due to time and/or system constraints. However, a 90 percent instrumentation operable criterion was used to insure an approximate force composition/ratio. Appendix B describes the total number of instrumented units planned for use in the test and the number of selected units that were used to generate mobility data.

(8) All test units underwent training to the level of the Army Training and Evaluation Program (ARTEP) standards prior to commencement of this test. The test was based upon the ARTEP for the Mechanized Infantry/ Tank Task Force (ARTEP 71-2 (Draft) and ARTEP 71-2-1 (Test)).

f. Trial Description.

(1) Trials began on 16 October 1977 and continued through 31 October 1977. The trials commenced again on 2 December 1977 and continued through 17 December 1977. Each trial was approximately 3 days long and consisted of three major events: movement to contact, active defense, and deliberate attack. The schedule for the timing of these events during each trial is shown in figure 1. Table 5 depicts the trial schedule for the battalion test.

(2) Each trial was generally flowing; however, administrative breaks were taken to check instrumentation to verify it was working properly. Instrumentation checks are indicated in figure 1.

(3) A maximum amount of free play within given boundaries was allowed for the tested unit. The control exercised by TCATA was the event; i.e., movement to contact, night defense, etc., conducted by the tested unit. The friendly brigade headquarters issued orders and guidance sufficient to cause the tested unit to accomplish the required operation. The threat force had maximum free play in the conduct of its operation; i.e., how the three battalions accomplished their prescribed tasks. However, each threat unit accomplished the overall mission as prescribed in the scenario/ sequence of events.

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Day 1 0600 1200 1800 2400 Day 2 0600 1200 1800 2400 Day 3 0600 1200 1800

Instrumentation check

Movement to contact

Instrumentation check

Night active defense

Instrumentation check

Day active defense

Instrumentation check

Tactical road march/assembly area operations

Instrumentation check

Deliberate attack
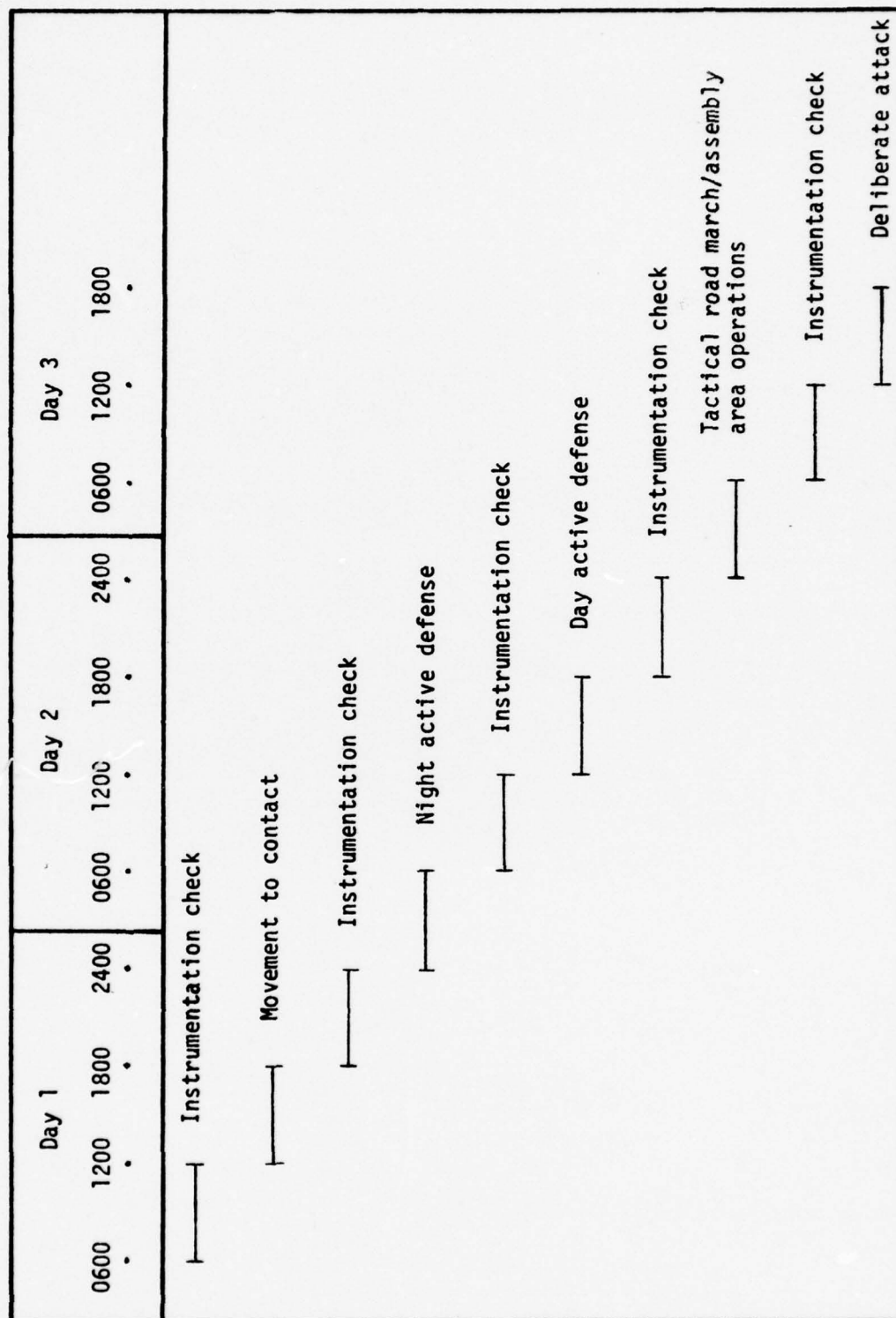
Figure 1. Battalion test trial event schedule

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Table 5. Battalion test trial schedule

Trial	Test Organization	Date
Trial 1	T-Series Tank Bn	16-18 Oct 77
Trial 2	H-Series Tank Bn	20-22 Oct 77
Trial 3	T-Series Mech Bn	24-26 Oct 77
Trial 4	H-Series Mech Bn	28-30 Oct 77
Trial 5	H-Series Tank Bn	2-4 Dec 77
Trial 6	T-Series Tank Bn	6-8 Dec 77
Trial 7	H-Series Mech Bn	10-12 Dec 77
Trial 8	T-Series Mech Bn	14-16 Dec 77

(4) In general, the events were terminated by schedule or if actual losses, both mechanical and instrumentation failures, and combat losses on tanks and TOWs reduced either side to 30 percent of the starting force composition.

g. <u>Instrumentation/Data Collection</u>. Data requirements for model inputs were identified prior to the battalion exercise and were incorporated into the data collection process at TCATA.

(1) Objective data was collected by the TCATA Automated Field Instrumentation System (TAFIS). This system consists of the Position Reporting and Recording System (PRRS), Automatic Data Collection System (ADCS), and the Weapons Engagement Scoring System (WESS). In general, objective data provided by TAFIS consisted of the following:

(a) Fire record - the identification of a system, its location, and the time it fired. No information concerning the target of a firing system was available unless a hit was scored.

(b) Hit record - the identification of the firer and the hit system, their locations, and the time of hit. No data as to extent of damage were available if the hit did not result in a kill.

(c) Kill record - the identification of the firer and the killed system, their locations, and the time of kill. Kills were determined internally in TAFIS and were based upon range and P_k tables.

(d) PRRS provided continuous locations (10-digit coordinates) of each instrumented system (tank and TOW).

(e) Portable Input Devices (PID) and Keyboard Input Devices (KID) were available to enter predetermined discrete coded events and time of entry into ADCS.

(2) Subjective data were manually recorded on evaluator forms during the exercise by trained/experienced evaluators. Evaluators were assigned to each platoon of the friendly organizations. The observations on command and control; i.e., movement/engagement sequences, were made by these evaluator personnel.

(3) Fire/hit/kill record data along with the position/location coordinates were transferred to CACDA on computer tapes. The organization-related data; e.g., specific movement, command/control times, and other subjective data, were forwarded on data collection forms.

2. DATA REDUCTION/ANALYSIS RESULTS.

a. <u>General</u>. This paper has the dual purpose of describing the data reduction methodology used for model input and of providing a comparative evaluation of the alternative organization based strictly on mobility. The test data requirements necessary to generate the requisite model inputs were

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stipulated in the TRADOC directive, subject: Requirements, Procedures, and Schedules for Transfer of Battalion Test Data from TCATA to CACDA, dated 3 October 1977 (appendix C). Table 6 summarizes these data requirements.

(1) Due to the problems TCATA encountered in providing "smoothed" Position Reporting and Recording System (PRRS) data, they forwarded a subset of the total PRRS data (with the remainder of the data to follow as soon as smoothing could be accomplished). This subset consisted of data elements that contained either no lane jumps or insignificant lane jumps of 90 meters or less. (Lane jumps are extreme instrumentation errors that are usually brief in duration.) Subsequent to examination/analysis, these data were considered sufficient to satisfy the immediate requirement of generating representative mobility rates for the alternative organizations.

(2) Unforeseen inadequacies in the data collection procedures developed by TCATA to collect command and control data precluded the collection of usable data for the first four trials. These procedures were subsequently revamped, and TCATA was able to collect command and control data for the second set of trials.

b. Data Reduction Methodology.

(1) CARMONETTE, as an expected value model, requires the mobility input data in the form of mean responses for varying slope classes (absolute in value) and vegetation/trafficability conditions per weapon system. To be in consonance with this model input requirement, the following slope and vegetation/trafficability categories were used.

(a) Slope.

1. Less than or equal to 6°.

2. Greater than 6° but less than or equal to 17°.

3. Greater than 17°.

(b) Vegetation/trafficability. (Trafficability denotes the existence of tank trails in the general direction of unit movement. The rationale for using this criterion was if tank trails were available the units would probably use them.)

1. Negligible vegetation/with or without existing tank trails.

2. Sparse vegetation/with or without existing tank trails.

3. Dense vegetation/with or without existing tank trails.

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Table 6. Battalion test data requirements

DATA REQUIREMENTS
Position Recording and Reporting System (PRRS) data
Automatic Data Collection System (ADCS) data
Voice Recording System (VRS) command and control data
Event scenarios/mission/commander's scheme of maneuver data
Aerial photographs

(2) Since the model is currently constrained to the simulation of daytime ground combat, only the day events were examined and analyzed. These events are movement to contact, active defense, and deliberate attack.

(3) Prior to receipt of the test data, each 1,000 meter grid square of the test area was assigned a vegetation/trafficability code. This determination was based upon military judgment using terrain maps and aerial photos.

(4) The PRRS data (consisting solely of x and y coordinates) were correlated with the Fort Hood digitized terrain data (consisting of x, y, and z components of the test terrain site) to ascertain the elevation component of vehicle path. Angular slope and movement rates were computed at approximately 15-second intervals from trial start to receipt of first fire (first recorded hit). This was done because the existing logic within CARMONETTE provides for the degradation of vehicle mobility when it comes under fire. The computation of mobility rates while under fire would, in effect, result in degrading the system twice over. With each 15-second computation, the x,y,z location of the weapon system was tagged with a vegetation/trafficability code. Once these computations were performed for each of the instrumented weapon systems, the mobility data were sorted and averaged by weapon type, slope, and vegetation/trafficability code for each trial event.

(5) Tables 7 through 29 contain the mean mobility data provided for model input. The designation of TOW (mech) weapon systems in these tables denotes TOWs that were attached to mechanized companies; therefore, these weapon systems were distinguished from pure TOW units. This distinction is made in all tables and figures where applicable. (The TOW (mech) mean mobility rates may or may not denote mechanized company movement rates; i.e., physical deployment of these TOWs was not discernible.) The empty cells in these tables denote the nonavailability of data for the particular model input conditions. The absense of data can probably be attributed to the fact that the weapon systems did not traverse terrain representing all slope and vegetation/trafficability type conditions. Furthermore, it must be remembered that only a subset of the data was used to generate these mean mobility rate tables. This subset of data excluded trial 5 (H-tank) - movement to contact event data entirely. If all the data had been available for reduction/analysis, there would have been fewer empty cells. A representative histogram plot of the discrete mobility data for the three trial events, aggregated over weapon system, vegetation/trafficability, and slope class, is at appendix D.

(6) The command and control data for trials 5 through 8 were manually extracted/reduced from unit evaluator forms. On these forms the evaluators recorded engagement/movement related information; e.g., when an order was issued, who issued the order, who the order was given to, when execution of the order was initiated. Tables 30 and 31 depict the mean engagement/movement response times computed for the T- and H-series organization, respectively. These data were pooled and averaged across weapon systems due to the small sample sizes. Comparison tests were not performed

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between the T- and H-series mean response times; the paucity and especially the variability of the data precluded the requisite statistical power for meaningful analysis results. However, examination of the evaluator forms revealed no apparent difference between the alternative organization with regard to command and control.

c. <u>Analysis Results</u>.

Table 7. Trial 1 (T-Tank) mobility rates (meters/second) - movement to contact

Vegetation/ Trafficability Condition	Weapon System					
	Tank			TOW		
	Slope Class			Slope Class		
	$S \leq 6°$	$6° < S \leq 17°$	$S > 17°$	$S \leq 6°$	$6° < S \leq 17°$	$S > 17°$
Negligible/ with Trails	3.16* (181)	2.83 (11)		4.59 (55)	6.19 (2)	
Negligible/ w/o Trails	3.29 (67)			4.06 (78)	3.65 (9)	
Sparse/with Trails	2.92 (909)	2.48 (40)		4.33 (764)	4.18 (25)	
Sparse/without Trails	2.81 (251)	2.61 (21)		4.62 (224)	4.49 (25)	
Dense/with Trails	2.85 (378)	3.13 (23)		4.07 (467)	4.41 (46)	
Dense/without Trails	2.60 (103)	1.90 (14)		4.02 (167)	3.72 (22)	

* Mean (sample size)

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Table 8. Trial 1 (T-Tank) mobility rates (meters/second) – active defense.

Vegetation/ Trafficability Condition	Weapon System					
	Tank			TON		
	Slope Class			Slope Class		
	$S \leq 6^\circ$	$6^\circ < S \leq 17^\circ$	$S > 17^\circ$	$S \leq 6^\circ$	$6^\circ < S \leq 17^\circ$	$S > 17^\circ$
Negligible/ with Trails	4.23* (364)	2.02 (1)		4.26 (159)	2.54 (3)	
Negligible/ w/o Trails	2.94 (60)			6.57 (28)		
Sparse/with Trails				3.87 (158)		
Sparse/with-out Trails	4.18 (82)	3.42 (1)		6.01 (28)		
Dense/with Trails						
Dense/with-out Trails						

* Mean (sample size)

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Table 9. Trial 1 (T-Tank) mobility rates (meters/second) - deliberate attack

Vegetation/ Trafficability Condition	Weapon System					
	Tank			TOW		
	Slope Class			Slope Class		
	$S \leq 6°$	$6°<S \leq17°$	$S > 17°$	$S \leq 6°$	$6°<S \leq17°$	$S > 17°$
Negligible/ with Trails	3.86* (503)	5.31 (25)		4.37 (449)	4.16 (12)	
Negligible/ w/o Trails	3.64 (174)			4.93 (131)		
Sparse/with Trails	3.90 (1260)	4.72 (84)		3.84 (760)	3.08 (31)	
Sparse/without Trails	4.50 (295)	4.87 (1)		4.91 (243)	5.70 (11)	
Dense/with Trails	3.49 (731)	4.84 (7)		3.70 (510)	5.31 (9)	
Dense/without Trails	3.68 (158)			2.88 (41)	2.61 (7)	

* Mean (sample size)

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Table 10. Trial 2 (H-Tank) mobility rates (meters/second) – movement to contact

Vegetation/Trafficability Condition	Weapon System					
	Tank			TOW		
	Slope Class			Slope Class		
	$S \leq 6°$	$6° < S \leq 17°$	$S > 17°$	$S \leq 6°$	$6° < S \leq 17°$	$S > 17°$
Negligible/with Trails	4.83* (20)			5.33 (16)		
Negligible/w/o Trails				4.84 (11)		
Sparse/with Trails	3.87 (609)	3.51 (18)		4.70 (89)	6.05 (5)	
Sparse/without Trails	4.22 (172)	3.48 (2)		4.31 (37)	4.88 (1)	
Dense/with Trails	4.00 (337)	3.84 (20)		5.26 (64)	4.04 (22)	
Dense/without Trails	4.80 (65)			2.70 (31)		

* Mean (sample size)

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Table 11. Trial 2 (H-Tank) mobility rates (meters/second) - active defense

Vegetation/ Trafficability Condition	Weapon System								
	Tank			TOW			TOW (Mech)		
	Slope Class			Slope Class			Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$> 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/ with Trails	5.31* (209)	3.21 (2)		5.56 (18)			5.85 (91)	3.29 (3)	
Negligible/ w/o Trails	4.79 (116)	5.67 (1)		4.52 (23)			7.79 (13)		
Sparse/ with Trails	5.20 (183)	4.76 (3)					4.59 (49)	4.36 (2)	
Sparse/ w/o Trails	4.62 (109)	4.03 (9)					4.42 (41)		
Dense/with Trails	4.67 (83)						2.90 (19)		
Dense/without Trails									

* Mean (sample size)

20

Table 12. Trial 2 (H-Tank) mobility rates (meters/second) - deliberate attack

Vegetation/ Trafficability Condition	Weapon System								
	Tank			TOW			TOW (Mech)		
	Slope Class			Slope Class			Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/ with Trails	4.80* (696)			3.07 (14)			4.72 (225)		
Negligible/ w/o Trails	4.22 (335)	7.13 (14)		3.75 (35)			5.02 (143)	6.36 (2)	
Sparse/ with Trails	3.67 (2805)	3.37 (71)		3.77 (115)	2.72 (5)		4.56 (354)	5.00 (8)	
Sparse/ w/o Trails	3.91 (1337)	3.13 (37)		4.03 (46)	2.48 (3)		4.93 (86)	3.72 (3)	
Dense/with Trails	3.58 (1757)	3.63 (67)		3.32 (100)	3.89 (11)		4.79 (331)	5.04 (11)	
Dense/without Trails	4.42 (213)			4.88 (4)			4.01 (146)		

* Mean (sample size)

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Table 13. Trial 3 (T-Mech) mobility rates (meters/second) - movement to contact

Vegetation/Trafficability Condition	Weapon System					
	Tank Slope Class			TOW Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/with Trails	4.29* (96)			5.12 (169)	7.13 (3)	
Negligible/w/o Trails	3.49 (38)			4.25 (222)	5.26 (19)	
Sparse/with Trails	3.31 (487)	2.98 (19)		4.61 (1029)	4.25 (57)	
Sparse/without Trails	3.00 (135)	2.36 (3)		4.77 (240)	3.59 (20)	
Dense/with Trails	3.49 (249)	3.52 (12)		4.43 (614)	4.79 (52)	2.75 (1)
Dense/without Trails	3.00 (84)	2.15 (40)		3.94 (245)	4.25 (31)	

* Mean (sample size)

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Table 14. Trial 3 (T-Mech) mobility rates (meters/second) - active defense

Vegetation/Traffic-ability Condition	Weapon System								
	Tank			TOW			TOW (Mech)		
	Slope Class			Slope Class			Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/with Trails	3.37* (43)			5.29 (237)	7.11 (1)		6.49 (78)		
Negligible/w/o Trails				5.13 (105)	7.29 (1)		4.60 (16)		
Sparse/with Trails				4.73 (109)	5.55 (4)		4.23 (6)		
Sparse/without Trails	3.90 (104)	3.70 (4)		4.36 (202)	5.05 (7)		5.31 (44)	4.79 (8)	
Dense/with Trails				3.40 (15)					
Dense/without Trails									

* Mean (sample size)

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Table 15. Trial 3 (T-Mech) mobility rates (meters/second) - deliberate attack

Vegetation/Trafficability Condition	Weapon System								
	Tank			TOW			TOW (Mech)		
	Slope Class			Slope Class			Slope Class		
	S ≤ 6°	6° < S ≤ 17°	S > 17°	S ≤ 6°	6° < S ≤ 17°	S > 17°	S ≤ 6°	6° < S ≤ 17°	S > 17°
Negligible/with Trails	4.06* (4)			5.42 (109)					
Negligible/w/o Trails				4.49 (125)					
Sparse/with Trails	3.68 (483)	2.72 (14)		4.43 (532)	3.26 (11)		4.21 (94)	3.77 (2)	
Sparse/without Trails	3.00 (597)	2.97 (72)		4.02 (218)	3.44 (38)		4.41 (79)	4.20 (4)	
Dense/with Trails	3.23 (574)	3.89 (54)		3.97 (704)	3.36 (37)		3.50 (107)	3.34 (3)	
Dense/without Trails	3.59 (280)	2.18 (27)		4.02 (144)	3.35 (43)		3.63 (2)		

* Mean (sample size)

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Table 16. Trial 4 (H-Mech) mobility rates (meters/second) - movement to contact

Vegetation/Trafficability Condition	Weapon System								
	Tank			TOW			TOW (Mech)		
	Slope Class			Slope Class			Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/ with Trails	5.00* (202)	5.76 (1)		6.10 (21)			4.36 (184)	3.03 (8)	
Negligible/ w/o Trails	3.65 (181)	3.34 (9)		5.07 (55)	5.06 (2)		4.54 (190)	5.77 (11)	
Sparse/with Trails	4.00 (878)	3.94 (18)		4.59 (164)	3.12 (3)		4.23 (386)	3.29 (5)	
Sparse/without Trails	4.09 (360)	4.11 (13)		4.62 (120)	2.91 (4)		4.14 (264)	4.59 (27)	
Dense/with Trails	4.04 (439)	3.64 (21)		4.39 (164)	5.45 (12)		3.90 (410)	4.93 (17)	
Dense/without Trails	3.37 (43)	2.96 (7)		4.73 (31)			4.39 (90)	2.66 (10)	

* Mean (sample size)

25

Table 17. Trial 4 (H-Mech) mobility rates (meters/second) - active defense

Vegetation/Trafficability Condition	Tank			TOW			TOW (Mech)		
	Slope Class			Slope Class			Slope Class		
	S ≤ 6°	6° < S ≤ 17°	S > 17°	S ≤ 6°	6° < S ≤ 17°	S > 17°	S ≤ 6°	6° < S ≤ 17°	S > 17°
Negligible/with Trails	4.86* (475)			5.34 (224)			5.75 (285)	5.12 (2)	
Negligible/w/o Trails	4.88 (42)			6.18 (75)	6.44 (3)		5.07 (177)	5.35 (3)	
Sparse/with Trails	4.85 (101)	5.08 (20)		6.00 (63)	7.32 (6)		6.25 (45)	8.39 (1)	
Sparse/without Trails	4.36 (133)			5.54 (66)	2.61 (1)		5.18 (6)		
Dense/with Trails	3.47 (59)	2.37 (5)		3.63 (29)			4.61 (20)		
Dense/without Trails									

Weapon System

* Mean (sample size)

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Table 18. Trial 4 (H-Mech) mobility rates (meters/second) - deliberate attack

Vegetation/Trafficability Condition	Weapon System								
	Tank			TOW			TOW (Mech)		
	Slope Class			Slope Class			Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/with Trails	6.25* (298)	5.95 (2)		5.34 (119)	7.78 (1)		3.44 (281)		
Negligible/w/o Trails	4.89 (112)	10.93 (2)		4.74 (90)			4.11 (43)		
Sparse/with Trails	4.42 (681)	4.25 (10)		4.65 (438)	6.80 (2)		4.04 (49)		
Sparse/without Trails	4.30 (258)			6.04 (80)			4.80 (18)	5.89 (1)	
Dense/with Trails	3.88 (248)	1.89 (4)		4.38 (166)	3.30 (3)		4.34 (5)		
Dense/without Trails	3.51 (154)	4.63 (3)		3.68 (62)	1.52 (5)		4.07 (75)	3.99 (2)	

* Mean (sample size)

27

Table 19. Trial 5 (H-Tank) mobility rates (meters/second) - active defense

Vegetation/ Trafficability Condition	Weapon System					
	Tank			TOW (Mech)		
	Slope Class			Slope Class		
	S ≤ 6°	6° < S ≤ 17°	S > 17°	S ≤ 6°	6° < S ≤ 17°	S > 17°
Negligible/ with Trails	3.20* (262)	3.08 (9)		4.74 (210)	3.62 (5)	
Negligible/ w/o Trails	4.29 (50)			5.40 (36)		
Sparse/with Trails	3.72 (281)	4.97 (20)		4.04 (58)	5.28 (17)	
Sparse/without Trails	3.81 (234)	2.63 (4)		3.65 (26)		
Dense/with Trails	4.22 (23)			4.47 (50)	4.47 (3)	
Dense/without Trails						

* Mean (sample size)

28

Table 20. Trial 5 (H-Tank) mobility rates (meters/second) - deliberate attack

Vegetation/ Trafficability Condition	Weapon System					
	Tank			TOW (Mech)		
	Slope Class			Slope Class		
	S ≤ 6°	6° < S ≤ 17°	S > 17°	S ≤ 6°	6° < S ≤ 17°	S > 17°
Negligible/ with Trails	4.38* (813)	3.87 (13)		5.99 (147)		
Negligible/ w/o Trails	4.74 (313)			5.43 (116)		
Sparse/with Trails	4.02 (2504)	6.83 (36)		4.85 (417)	4.12 (8)	
Sparse/with-out Trails	3.98 (552)	3.19 (112)		4.28 (175)	4.15 (26)	
Dense/with Trails	4.49 (1274)	4.58 (116)		4.56 (218)	4.99 (19)	
Dense/with-out Trails	4.58 (54)			5.30 (9)		

* Mean (sample size)

29

Table 21. Trial 6 (T-Tank) mobility rates (meters/second) - movement to contact

Vegetation/ Trafficability Condition	Weapon System					
	Tank			TOW		
	Slope Class			Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/ with Trails	4.29* (89)	3.69 (2)				
Negligible/ w/o Trails	4.33 (26)			4.52 (18)	4.96 (3)	
Sparse/with Trails	3.39 (1175)	3.61 (31)		4.22 (326)	3.86 (12)	
Sparse/with- out Trails	3.44 (378)	3.95 (3)		3.95 (151)	1.98 (3)	
Dense/with Trails	3.52 (395)	3.09 (41)		4.41 (202)	4.97 (16)	
Dense/with- out Trails	2.97 (29)			4.29 (75)	3.33 (25)	

* Mean (sample size)

30

Table 22. Trial 6 (T-Tank) mobility rates (meters/second) - active defense

Vegetation/Trafficability Condition	Weapon System					
	Tank Slope Class			TON Slope Class		
	$S \le 6^0$	$6^0 < S \le 17^0$	$S > 17^0$	$S \le 6^0$	$6^0 < S \le 17^0$	$S > 17^0$
Negligible/with Trails	4.19* (532)	5.75 (3)		4.18 (211)		
Negligible/w/o Trails	4.72 (157)	2.19 (1)		4.98 (175)	2.26 (4)	
Sparse/with Trails	4.62 (357)	6.69 (4)		7.27 (29)		
Sparse/without Trails	4.38 (349)	3.12 (48)		4.95 (113)	6.26 (3)	
Dense/with Trails						
Dense/without Trails						

* Mean (sample size)

Table 23. Trial 6 (T-Tank) mobility rates (meters/second) - deliberate attack

Vegetation/Trafficability Condition	Weapon System					
	Tank			TON		
	Slope Class			Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/with Trails	4.84* (51)			4.53 (110)		
Negligible/w/o Trails	3.42 (18)					
Sparse/with Trails	3.72 (1154)	3.08 (20)		3.79 (654)	3.79 (23)	
Sparse/without Trails	2.72 (902)	2.17 (110)		3.05 (160)	2.44 (22)	
Dense/with Trails	3.24 (937)	2.84 (33)		3.24 (382)	3.05 (7)	
Dense/without Trails				3.70 (1)		

* Mean (sample size)

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Table 23. Trial 6 (T-Tank) mobility rates (meters/second) - deliberate attack

Vegetation/ Trafficability Condition	Weapon System					
	Tank			TOW		
	Slope Class			Slope Class		
	$S \leq 6^o$	$6^o < S \leq 17^o$	$S > 17^o$	$S \leq 6^o$	$6^o < S \leq 17^o$	$S > 17^o$
Negligible/ with Trails	4.84* (51)			4.53 (110)		
Negligible/ w/o Trails	3.42 (18)					
Sparse/with Trails	3.72 (1154)	3.08 (20)		3.79 (654)	3.79 (23)	
Sparse/without Trails	2.72 (902)	2.17 (110)		3.05 (160)	2.44 (22)	
Dense/with Trails	3.24 (937)	2.84 (33)		3.24 (382)	3.05 (7)	
Dense/without Trails				3.70 (1)		

* Mean (sample size)

Table 24. Trial 7 (H-Mech) mobility rates (meters/second) - movement to contact

Vegetation/ Trafficability Condition	Weapon System					
	Tank			TOW (Mech)		
	Slope Class			Slope Class		
	$S \le 6^0$	$6^0 < S \le 17^0$	$S > 17^0$	$S \le 6^0$	$6^0 < S \le 17^0$	$S > 17^0$
Negligible/ with Trails	6.63* (12)	4.40 (1)		5.67 (30)	6.01 (1)	
Negligible/ w/o Trails	3.99 (29)	3.45 (6)		5.02 (30)		
Sparse/with Trails	3.98 (624)	2.87 (17)		4.10 (645)	4.69 (12)	
Sparse/with- out Trails	3.66 (179)			4.15 (250)	3.86 (16)	
Dense/with Trails	4.26 (238)	4.25 (13)		4.40 (322)	4.70 (17)	
Dense/with- out Trails	2.78 (150)	2.52 (51)		3.83 (189)	2.96 (38)	

* Mean (sample size)

33

Table 25. Trial 7 (H-Mech) mobility rates (meters/second) - active defense

Vegetation/Trafficability Condition	Tank Slope Class			TOW Slope Class			TOW (Mech) Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/with Trails	5.41* (260)	6.12 (3)		5.06 (151)			5.49 (628)	8.20 (1)	
Negligible/w/o Trails	6.00 (17)			5.16 (49)			5.66 (251)		
Sparse/with Trails	4.94 (210)	5.39 (11)		4.61 (151)	4.17 (4)		5.33 (290)	7.28 (9)	
Sparse/without Trails	4.60 (105)			4.30 (39)			4.78 (39)	6.95 (2)	
Dense/with Trails	4.61 (33)	3.89 (2)		4.74 (36)	4.78 (4)		4.75 (25)		
Dense/without Trails				5.02 (10)					

Weapon System

* Mean (sample size)

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Table 26. Trial 7 (H-Mech) mobility rates (meters/second) – deliberate attack

Vegetation/ Trafficability Condition	Weapon System								
	Tank			TOW			TOW (Mech)		
	Slope Class			Slope Class			Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/ with Trails	5.43* (652)	1.68 (1)		5.49 (294)			5.45 (791)		
Negligible/ w/o Trails	5.66 (4)			6.07 (4)			5.48 (113)		
Sparse/with Trails	3.55 (355)	4.05 (6)		3.96 (124)	3.33 (3)		4.26 (372)	3.44 (10)	
Sparse/without Trails	3.57 (70)	3.78 (1)		4.67 (35)			3.49 (106)	4.28 (1)	
Dense/with Trails	4.95 (156)			5.66 (103)			4.55 (192)	3.84 (34)	4.66 (5)
Dense/without Trails	3.74 (112)	3.35 (8)		4.87 (89)	4.06 (3)		5.56 (118)		

* Mean (sample size)

35

Table 27. Trial 8 (T-Mech) mobility rates (meters/second) – movement to contact

Vegetation/Trafficability Condition	Tank Slope Class			TON Slope Class		
	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$	$S \leq 6^0$	$6^0 < S \leq 17^0$	$S > 17^0$
Negligible/ with Trails	3.58* (32)	4.52 (2)		7.36 (19)		
Negligible/ w/o Trails	3.48 (193)	3.46 (4)		5.48 (22)	9.34 (2)	
Sparse/with Trails	3.48 (309)	2.29 (15)		4.82 (149)	4.33 (3)	
Sparse/with-out Trails	3.16 (180)	3.38 (5)		4.02 (78)	4.76 (7)	
Dense/with Trails	3.37 (333)	2.65 (18)		4.99 (137)	5.16 (8)	
Dense/with-out Trails	3.03 (61)	3.47 (5)		1.68 (9)		

Weapon System

* Mean (sample size)

Table 28. Trial 8 (T-Mech) mobility rates (meters/second) - active defense

Vegetation/ Trafficability Condition	Weapon System					
	Tank			TOW		
	Slope Class			Slope Class		
	$S \leq 6°$	$6° < S \leq 17°$	$S > 17°$	$S \leq 6°$	$6° < S \leq 17°$	$S > 17°$
Negligible/ with Trails	4.40* (116)	6.49 (1)		4.94 (90)	6.05 (1)	
Negligible/ w/o Trails	3.94 (134)	7.68 (1)		5.56 (5)		
Sparse/with Trails	4.29 (186)	5.44 (11)		4.53 (262)	3.95 (27)	4.36 (6)
Sparse/with-out Trails	4.38 (135)	4.10 (16)		4.94 (35)		
Dense/with Trails						
Dense/with-out Trails						

* Mean (sample size)

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Table 29. Trial 8 (T-Mech) mobility rates (meters/second) - deliberate attack

Vegetation/Trafficability Condition	Weapon System					
	Tank			TON		
	Slope Class			Slope Class		
	S ≤ 6°	6° < S ≤ 17°	S > 17°	S ≤ 6°	6° < S ≤ 17°	S > 17°
Negligible/ with Trails	5.49* (625)	2.07 (1)		4.76 (438)		
Negligible/ w/o Trails	3.73 (146)			3.98 (171)		
Sparse/with Trails	3.56 (246)	5.10 (7)		3.86 (162)	5.44 (1)	
Sparse/without Trails	3.75 (30)			4.61 (33)	4.26 (2)	
Dense/with Trails	3.43 (431)			3.56 (126)		
Dense/without Trails	3.81 (215)	3.96 (6)		3.88 (58)	4.48 (1)	

* Mean (sample size)

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Table 30. Command and control response times (minutes) - engagement commands

Trial	Event	Mean*	Std Dev	Sample Size
H-Tank	Movement to Contact	2.30	4.60	10
	Active Defense	2.89	3.60	19
	Deliberate Attack	2.42	2.54	12
T-Tank	Movement to Contact	2.33	3.99	18
	Active Defense	1.29	2.31	21
	Deliberate Attack	.88	1.73	8
H-Mech	Movement to Contact	1.17	1.17	6
	Active Defense	1.50	1.95	32
	Deliberate Attack	2.08	2.84	12
T-Mech	Movement to Contact	2.50	3.54	2
	Active Defense	.77	1.59	13
	Deliberate Attack	.67	1.63	6

* These mean times reflect the elapsed time between the issuance of an enemy sighting report to a higher element and the subsequent receipt of an order by a subordinate element to engage.

Table 31. Command and control response times (minutes) - movement commands

Trial	Event	Mean*	Std Dev	Sample Size
H-Tank	Movement to Contact	2.87	2.28	31
	Active Defense	1.76	2.23	21
	Deliberate Attack	1.09	1.75	32
T-Tank	Movement to Contact	2.21	3.10	28
	Active Defense	2.71	2.80	21
	Deliberate Attack	1.46	1.81	13
H-Mech	Movement to Contact	2.53	4.14	19
	Active Defense	1.43	2.18	28
	Deliberate Attack	1.68	2.97	22
T-Mech	Movement to Contact	3.04	2.96	25
	Active Defense	3.00	3.54	17
	Deliberate Attack	.50	.84	6

* These mean times reflect the elapsed time between the issuance of a movement order to a subordinate element and the subsequent initiation of movement.

c. Analysis Results.

(1) The objective of this analysis was to provide a comparative "look" at the alternative organization based on the mobility data generated. Pairwise comparisons were performed on the overall mean mobility rates for the alternative organizations by weapon system (tables 32, 33, and 34 contain these overall means). The two sets of trials, 1 through 4 and 5 through 8, were not aggregated for similar organizations because the data from trials 1 through 4 were received and analyzed first and separately from the second set of data (trials 5 through 8). It is pointed out that these second set of trials were more structured as a result of the lessons learned from trials 1 through 4.

(2) A T-test, which is robust with respect to non-normality, was used to determine the statistical equality between pairs of overall means from the first and second sets of trials for similar weapon systems/organizations. The results revealed that the mean rates were significantly different in 17 of the 24 T-/H-series pairs tested. In ten of these pairs the mean mobility rate increased in the second set of trials but decreased for the other seven (this was irrespective of weapon system/organization). Several likely explanations for these results can be cited.

o A bias may have existed in the subset of data analyzed. This possible bias was not manifested in a consistent manner because the subset of data received from TCATA varied from event to event, trial to trial.

o Possibly the more rigid structure of the second set of trials coupled with the introduction of a new set of player battalions affected the mobility rates of the tested battalions.

o Some other unknown factor(s) may have entered into the test.

More than likely a combination of the above influenced the mobility rates of the alternative organizations.

(3) The results of comparative analyses between alternative organizations on the mean mobility rates for the first and second sets of trials is depicted in table 35. In 14 of the 21 tests performed, the H-series weapon systems demonstrated the faster mean movement rate. Of the remaining seven, the T-series weapon systems had the faster movement rates in two of the tests, with the results of the other five tests showing no significant difference. No particular cause can be singled out for these results as they are contradictory to what was initially expected; i.e., the T-series battalion should be more maneuverable and hence move more quickly. A possible explanation is the extreme degrees of familiarity and experience the player battalions had with the alternative organizations. The player battalions, especially the commanders, had trained and been indoctrinated for a greater part of their military careers in the H-series organization, but only

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Table 32. Overall tank mean mobility rates (meters/second)

Trial (Series)	Trial Event		
	Movement to Contact	Active Defense	Deliberate Attack
1 (T-Tank)	2.89/1.55* (1998)	4.06/1.91 (508)	3.82/1.89 (3237)
2 (H-Tank)	4.01/1.99 (1243)	4.99/2.18 (715)	3.85/1.91 (7352)
3 (T-Mech)	3.33/1.68 (1163)	3.74/1.97 (151)	3.31/1.59 (2105)
4 (H-Mech)	4.07/2.13 (2172)	4.67/1.93 (835)	4.59/2.50 (1772)
5 (H-Tank)		3.66/1.93 (883)	4.23/2.27 (5787)
6 (T-Tank)	3.45/1.41 (2128)	4.37/2.02 (1451)	3.25/1.51 (3225)
7 (H-Mech)	3.81/1.91 (1320)	5.10/2.12 (641)	4.63/2.22 (1365)
8 (T-Mech)	3.35/1.81 (1157)	4.28/1.88 (600)	4.29/2.23 (1707)

* Mean/standard deviation (sample size)

Table 33. Overall TOW mean mobility rates (meters/second)

Trial (Series)	Trial Event		
	Movement to Contact	Active Defense	Deliberate Attack
1 (T-Tank)	4.33/2.43* (1884)	4.39/2.03 (376)	4.08/2.17 (2204)
2 (H-Tank)	4.57/2.32 (276)	4.98/2.03 (41)	3.62/1.64 (326)
3 (T-Mech)	4.52/2.02 (2702)	4.86/2.26 (681)	4.18/1.86 (1961)
4 (H-Mech)	4.65/2.46 (576)	5.51/2.16 (467)	4.74/2.40 (966)
5 (H-Tank)			
6 (T-Tank)	4.21/1.84 (831)	4.77/2.38 (535)	3.58/1.93 (1359)
7 (H-Mech)		5.00/2.16 (444)	5.09/2.43 (655)
8 (T-Mech)	4.83/2.56 (434)	4.63/2.21 (426)	4.26/2.06 (992)

* Mean/standard deviation (sample size)

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Table 34. Overall TOW (mech) mean mobility rates (meters/second)

Trial (Series)	Trial Event		
	Movement to Contact	Active Defense	Deliberate Attack
1 (T-Tank)			
2 (H-Tank)		5.11/2.47 (218)	4.67/2.10 (1309)
3 (T-Mech)		5.77/2.38 (152)	3.99/1.81 (291)
4 (H-Mech)	4.20/1.99* (1602)	5.52/2.42 (539)	3.73/3.11 (474)
5 (H-Tank)		.4.60/2.45 (405)	4.90/2.47 (1135)
6 (T-Tank)			
7 (H-Mech)	4.17/1.98 (1550)	5.47/2.36 (1245)	4.94/2.35 (1742)
8 (T-Mech)	.		

* Mean/standard deviation (sample size)

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Table 35. Results of pairwise comparisons on the mean mobility rates (meters/second) - T- versus H-series organization

Trial (Series) versus Trial (series) (organization)	Movement to Contact — Weapon System			Active Defense — Weapon System			Deliberate Attack — Weapon System		
	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)
1(T-)vs/2(H-) (Tank)	2.89[a]/4.01	4.33[b]/4.57		4.06/4.99	4.39/4.98		3.82[b]/3.85	4.08/3.62	
3(T-)vs/4)H-) (Mech)	3.33/4.07	4.52[b]/4.65		3.74/4.67	4.86/5.51	5.77[b]/5.52	3.31/4.59	4.18/4.74	3.99[b]/3.73
5(H-)vs/6(T-) (Tank)				3.66/4.37			4.23/3.25		
7(H-)vs/8(T-) (Mech)	3.81/3.35			5.10/4.28	5.00/4.63		4.63/4.29	5.09/4.26	

[a] Overall weapon system mean mobility rates for the alternative organizations.
[b] No significant difference between mean mobility rates.

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several months in the T-series organization. Because of their unfamiliarity and lack of confidence in the T-series configuration, the player battalions moved without the authority that comes with years of training.

(4) An analysis of variance was performed on the mobility rate data to determine the statistical significance of weapon system and vegetation/ trafficability category. The results of this analysis are at appendix E.

(5) It appears that the mean mobility rates may be relatively slow; but when comparing these mean rates to the movement rates used in the Battalion Analyzer and Tactical Trainer for Local Engagements (BATTLE) model, a terrain board exercise used to train officers in field exercises, they compare favorably. To get a better picture of the variation in these mobility rates, the data per weapon system are presented in groups according to the magnitude of the mobility rates; i.e., deciles, in appendix F.

3. CONCLUSIONS.

a. The analyses results indicate that the H-series organization moved significantly faster; i.e., was more maneuverable, than the T-series organization. No valid analysis can be presented to support the evaluation of command and control; however, in examining the subjective data collected, it appears that command and control was equally effective in both organizations.

b. It must be emphasized that this paper addresses only the mobility portion of the vast amount of data collected in the battalion test. Consequently, one must look to the TCATA final report for a conclusive statement regarding a *total evaluation of the* alternative organizations based on the battalion field test.

REFERENCES

1. HQ, TRADOC Combined Arms Test Agency (TCATA), Fort Hood, Texas, <u>Division Restructuring Study, FM 382, Detailed Plan for Execution</u> (Draft), 30 Aug 77

2. Ostle, B (1966), <u>Statistics in Research</u>, Iowa State University Press, Ames, Iowa

3. Neter, J. and Wasserman, W. (1974), <u>Applied Linear Statistical Models</u>, R. D. Irwin, Inc., Homewood, Illinois

4. TCATA, Fort Hood, Texas, <u>Test Concept for Maneuver Battalion Test</u> (Draft), 17 Feb 77

APPENDIX A

DESCRIPTION OF TRIAL EVENTS

A-1. Figures A-1 through A-3 are copies of computer graphics displays of representative terrain sites, represented by 100-meter grid squares for a 6-kilometer area, used for the movement to contact, active defense, and deliberate attack events, respectively. Defensive positions are marked in the general area of actual unit deployment, and approximate routes of attack are also sketched on the displays.

A-2. A general description of the five trial events follows.

   a. Movement to Contact. At 0600 hours the tested unit received a fragmentary order for the conduct of a movement to contact to secure battle positions and prepare to conduct an active defense. Line of departure time was approximately 1200 hours.

   b. Night Defense. The movement to contact ended approximately at 1800 hours D-day. During the instrumentation period, 1800-2400, reconnaissance and defensive preparations were made. At 0001 the tested unit was in position and prepared to defend. This defense continued until one of the ending criteria was satisfied.

   c. Day Defense. During the instrumentation phase, 0600-1200 hours, D+1, a fragmentary order was issued to the tested battalion to reconstitute its defense in a new sector. The tested unit was in position by 1200 hours. This defense continued until one of the ending criteria was satisfied.

   d. Assembly Area and Tactical Road March. At 2000 hours, D+1, the tested battalion was issued a fragmentary order to conduct a road march and to close on an assembly area, not later than 0400 hours, D+2, and to prepare to conduct a deliberate attack on D+2. Start time was approximately 0001 hours, D+2, for the tactical road march.

   e. Deliberate Attack. The brigade commander issued a fragmentary order for the conduct of the deliberate attack at 0600, D+2. The attack commenced at 1200 hours, D+2, and continued until the objective was secured, or the ending criterion was satisfied.

A-1

Blue unit routes

$(6_{14}000, 34_{61}000)$

$(6_{14}000, 34_{55}000)$

$(6_{08}000, 34_{55}000)$

$(6_{08}000, 34_{61}000)$

Red defensive positions

Figure A-1. Battalion test terrain site - movement to contact
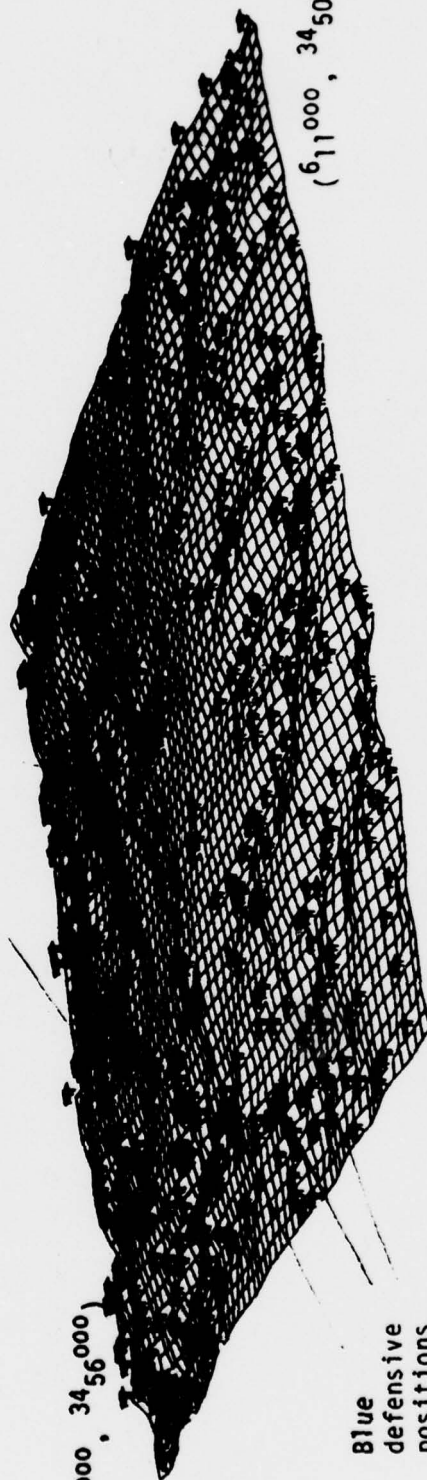
Figure A-2. Battalion test terrain site - active defense

$(6_{14000}, 34_{52000})$

$(6_{14000}, 34_{58000})$

Blue unit routes

Red defensive positions

$(6_{08000}, 34_{52000})$

$(6_{08000}, 34_{58000})$
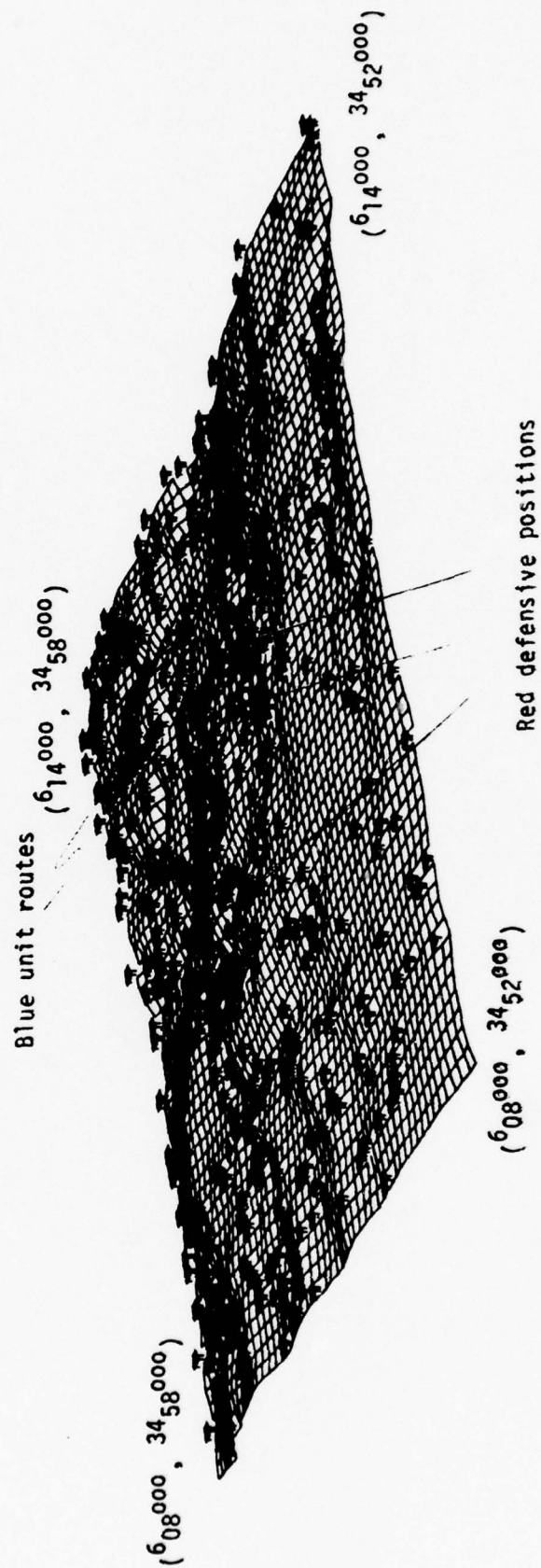
Figure A-3. Battalion test terrain site - deliberate attack

A-4

APPENDIX B

INSTRUMENTED SYSTEMS USED FOR DATA REDUCTION

Tables B-1 and B-2 contain the total number of instrumented systems planned for use in the battalion test and the total number of systems that were actually used for data reduction; i.e., those for which Position Reporting and Recording System (PRRS) data were available. This subset of data that was used to generate mobility rates contained either no lane jumps or insignificant lane jumps of 90 meters or less.

B-1

Table B-1. Blue force instrumented systems (planned/available for data reduction*) - defense

Trial (Series)	Instrumented Systems		
	Planned	Available for data reduction	Percent (Available/Planned)
1 (T-TK)	37	19	51
2 (H-TK)	40	27	68
3 (T-Mech)	26	13	50
4 (H-Mech)	37	26	70
5 (H-TK)	40	17	43
6 (T-TK)	34	22	65
7 (H-Mech)	37	23	62
8 (T-Mech)	23	17	74

* Systems whose PRRS data contained at worst insignificant lane jumps.

Table B-2. Blue force instrumented systems (planned/available for data reduction*) - attack

Trial (Series)	Instrumented Systems		
	Planned	Available for data reduction	Percent (Available/Planned)
1 (T-TK)	37	21	57
2 (H-TK)	40	29	73
3 (T-Mech)	26	19	73
4 (H-Mech)	37	21	57
5 (H-TK)	40	28	70
6 (T-TK)	34	19	56
7 (H-Mech)	37	26	62
8 (T-Mech)	23	14	61

* Systems whose PRRS data contained at worst insignificant lane jumps.

APPENDIX C

TRADOC LETTER OF BATTALION TEST DATA REQUIREMENTS

This appendix provides a facsimile of the TRADOC letter regarding requirements, procedures, and schedules for transfer of battalion test data from TCATA to CACDA.

DEPARTMENT OF THE ARMY
UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
OFFICE OF THE DEPUTY COMMANDING GENERAL
FORT LEAVENWORTH, KANSAS 66027

ATCA-CAT-D   3 October 1977

SUBJECT: Requirements, Procedures, and Schedules for Transfer of
          Battalion Test Data from TCATA to CACDA

Commander
US Army TRADOC Combined Arms Testing Agency
Fort Hood, Texas 76544

1. To support the Division Restructure Evaluation (DRE), timely trans-
fer of data from TCATA to CACDA is essential. This letter specifies
the minimum data required by CACDA to conduct the necessary analyses
within the DRE Phase I time frame. In order for CACDA to meet an ex-
tremely tight analysis schedule, it is critical that CACDA receive
TCATA data according to the schedule outlined below.

2. Data should be provided on an individual trial basis. TCATA will
provide data on computer tapes in a manner similar to that used for
delivery of maps, pictures, and subjective data such as evaluation
forms, etc. It is necessary that most of the quantitative data from
the test be screened, condensed, and formated before transmission to
CACDA.

3. The actual trial data description and the schedule for delivery to
CACDA for planning purposes will be as follows:

    a. Ten days after completion of each trial. Descriptive informa-
tion about the trial conditions to include type of trial, start/stop
times, weather conditions, player/vehicle/weapon identification correla-
tion tables, and trial area used should be forwarded to CACDA.

    b. Twenty-one days after completion of each trial, the following
data, as well as a description of the formats utilized, should be
supplied:

        (1) Position Reporting and Recording System (PRRS) data should
be smoothed and consist of UTM coordinates, player ID, and time, given
every one or ten seconds of trial time for all instrumented player
elements. The TCATA format is acceptable so long as it contains the
information shown at inclosure 1.

C-2

SUBJECT: Requirements, Procedures, and Schedules for Transfer of
           Battalion Test Data from TCATA to CACDA

        (2) Reduced fire, hit and artillery data from the Automatic
Data Collection System (ADCS). The TCATA formats are acceptable so
long as they contain the information shown at inclosures 2 and 3.

        (3) Actual kill probabilities used during the conduct of the
trial.

        (4) Command and control data (e.g., time, type, sender, and
recipient of orders) should be reduced and formated similar to that
shown at inclosure 4. Data describing the issue of all orders at
battalion and company level affecting platoon movement are required.

        (5) Reports, results files, and raw data files as identified
in inclosure 5. These forms are subject to changes that may occur in
the data evaluation forms contained in Annex 3 to Appendix E of the
Detailed Plan for Execution, 30 August 1977. Additionally, other
results files and raw data forms will be made available to CACDA for
review at TCATA in the event that they are required.

        (6) Color aerial photos of trial areas taken during the trial,
on the ground photos from selected and occupied defender and threat
positions (to be coordinated with CACDA), and terrain maps of the trial
area (only one initial set required) should be provided.

4. Additional Considerations. If other data from ADCS is identified
as required for CACDA simulations, the requirement will be coordinated
with TCATA.

5. Point of contact at CACDA concerning the quantitative data transfer
requirements is Mr. Jack Low, Autovon 552-5285/3981. Point of contact
at CACDA concerning the qualitative data transfer requirements is Mr.
Rudolph Pabon, Autovon 552-5285/3981.

                                        /s/
5 Incl   J. R. THURMAN
as   Lieutenant General, USA
                                        Deputy Commander

CF:
HQ, TRADOC, ATTN: ATRM, Ft Monroe, VA 23651
HQ, TRADOC, ATTN: ATCD-PG, Combat Developments Planning Group,
   Ft Monroe, VA 23651

PRRS FILE

Position	Contents	
1	Trial Number	
2	Blank	
3-4	Hours	
5	Blank	
6-7	Minutes	From Start of Trial
8	Blank	
9-10	Seconds	
11	Blank	
12-14	Player ID Number	
15	Blank	
16-21	UTM (X)	
22	Blank	
23-28	UTM (Y)	
29-80	Blank	

Incl 1

HIT FILE

POSITION	CONTENTS
1-3	BPD Number of Unit Hit
4-8	Julian Date YYDDD
9-10	Hours
11-12	Minutes
13-14	Seconds
15-17	SPCLU # of Hit Unit
18-20	SPCLU # of Attacker 1; XXX
21-23	SPCLU # of Attacker 2; if 255, then this is Killer & XXX = Killer ID
24-25	Time Tag of Attacker 1
26-27	Time Tag of Attacker 2
28-30	MU # of Hit Unit
31-32	MU Flags (HEX representation)
33	MU Mode
34-39	East Coord of hit unit
40-45	North Coord of hit unit
46-47	Weapon Type of hit unit 1-16
48-49	Vehicle Type of Hit unit 1-16
50-52	MU # of Attacker 1
53-54	MU Flags (HEX representation)
55	MU Mode
56-61	East coord of Ak 1
62-67	North coord of Ak 1
68-69	Weapon Type of Attacker 1 1-16
70-71	Vehicle Type of Attacker 1 1-16
72-74	MU # of Attacker 2
75-76	MU Flags (HEX representation)
77	MU Mode
78-83	East Coord of Ak 2
84-89	North Coord of Ak 2
90-91	Weapon Type of Attacker 2
92-93	Vehicle Type of Attacker 2
94	If 1-attack 1 is invalid, if 0, attack 1 is valid
95	If 1-attack 2 is invalid, if 0, attack 2 is valid

Incl 2

C-5

FIRE FILE

POSITION	CONTENTS
1-3	BPD Number of Firing Unit
4-8	Julian Date YYDDD
9-10	Hours
11-12	Minutes
13-14	Seconds 37 or 43
15-17	SPCLU # of Firing Unit
18-20	MU # of Firing Unit
21-22	MU Flags (HEX representation)
23	MU Mode, 1=Man, etc.
24-29	East Coord
30-35	North Coord
36-37	Weapon Type of Firer
38-39	Vehicle Type of Firer
*	No Hit or Kill
40	Fire Code (F)
41-95	Filler

Incl 3

COMMAND AND CONTROL FILE

Position	Contents	
1	Trial Number	
2	Blank	
3-4	Hours	
5	Blank	Time Command Sent from
6-7	Minutes	Start of Trial*
8	Blank	
9-10	Seconds	
11	Blank	
12-14	Sender ID Number	
15	Blank	
16-17	Hours	
18	Blank	Time Command Received by
19-20	Minutes	Receiver #1 from Start of Trial
21	Blank	
22-23	Seconds	
24	Blank	
25-27	Receiver #1 ID Number	
28	Blank	
29-30	Hours	
31	Blank	
32-33	Minutes	Time Command Received by Receiver #2
34	Blank	from Start of Trial
35-36	Seconds	
37	Blank	
38-40	Receiver #2 ID Number	
41	Blank	
42-43	Hours	
44	Blank	
45-46	Minutes	Time Command Received by
47	Blank	Receiver #3 from Start of Trial
48-49	Seconds	
50	Blank	
51-53	Receiver #3 ID Number	
54-80	Blank	

*If there is no entry for either a sender or receiver ID or associated
time for that sender or receiver, all fields for the time and ID for
that sender/receiver should be filled by -1.

DATA FORMS, FILES, AND REPORT REQUIREMENTS

A. VRS I, II Reports.*

B. Computer Reports.

C. Results Files:

   C-1-12

   C-1-24

   C-1-27

   C-4-71

D. Raw Data Files:

Objective 1	Objective 2	Objective 3	Objective 4
S-1-5			S-4-2
			S-4-9
			S-4-10
			S-4-11

*VRS II reports will not be required until January 1978.

Incl 5

C-8

APPENDIX D

HISTOGRAM PLOTS OF MOBILITY DATA

D-1. Subsequent to the computation of mobility data for the trial 1 events, histogram plots of the event data were made and found to be bimodal. The primary mode of the data occurred beyond 1.0 meters/second while the secondary mode occurred at 1.0 meters/second or less. This secondary mode was attributed to inherent instrumentation errors and used as a truncation point; i.e., all values at or below the secondary mode were deleted from analysis.

D-2. This censoring of the data was justified because the PRRS has instrumentation accuracy to within $\pm$ 10 meters of a stationary object. This corresponds to a movement rate of approximately 1 meter/second when using position data at 10 to 15 second intervals; i.e., when a vehicle, in fact, was stationary, the instrumentation would record movement. This bimodality occurred throughout the trial events and was resolved accordingly.

D-3. Figures D-1 through D-3 depict representative trial event histogram plots of the mobility data generated, aggregated over weapon system, vegetation/trafficability, and slope class.
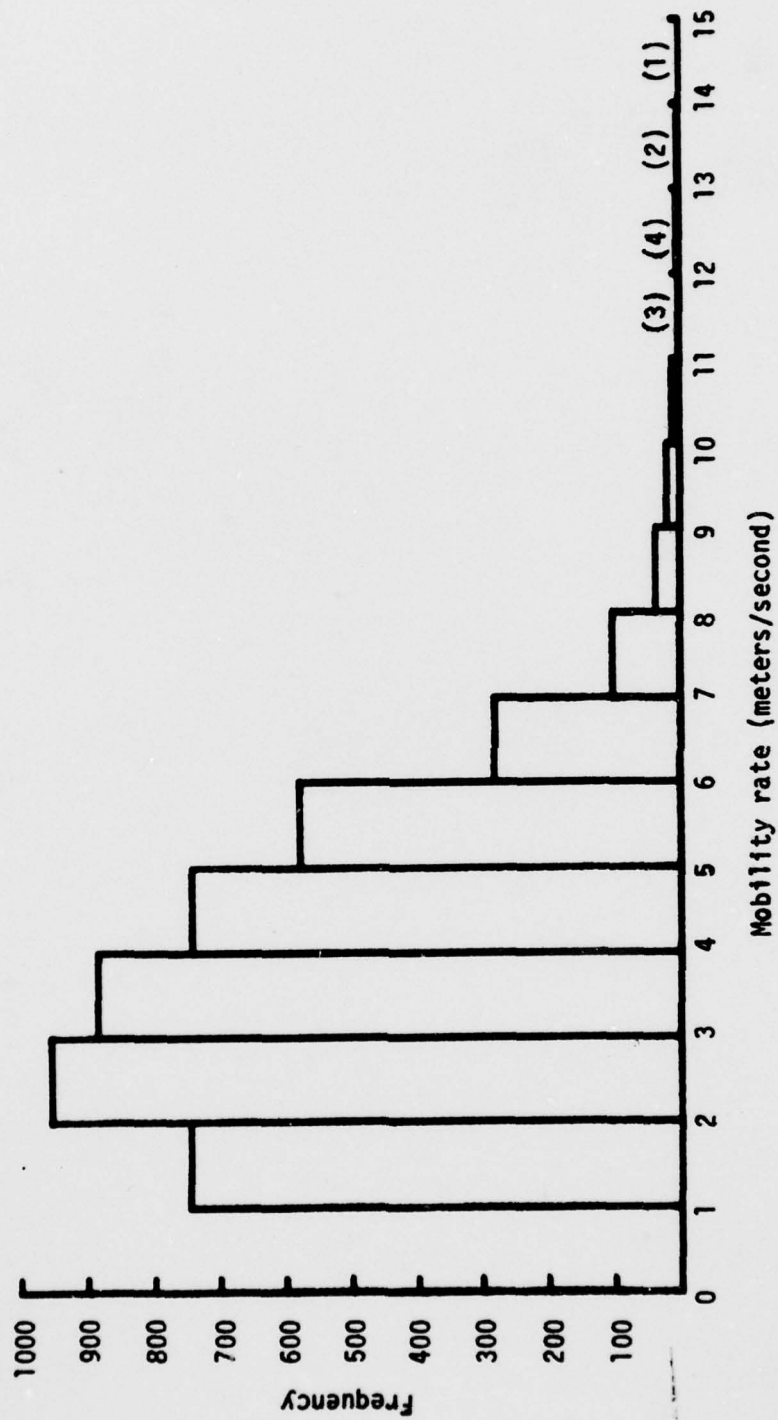
Figure D-1. Histogram plot of deliberate attack event data
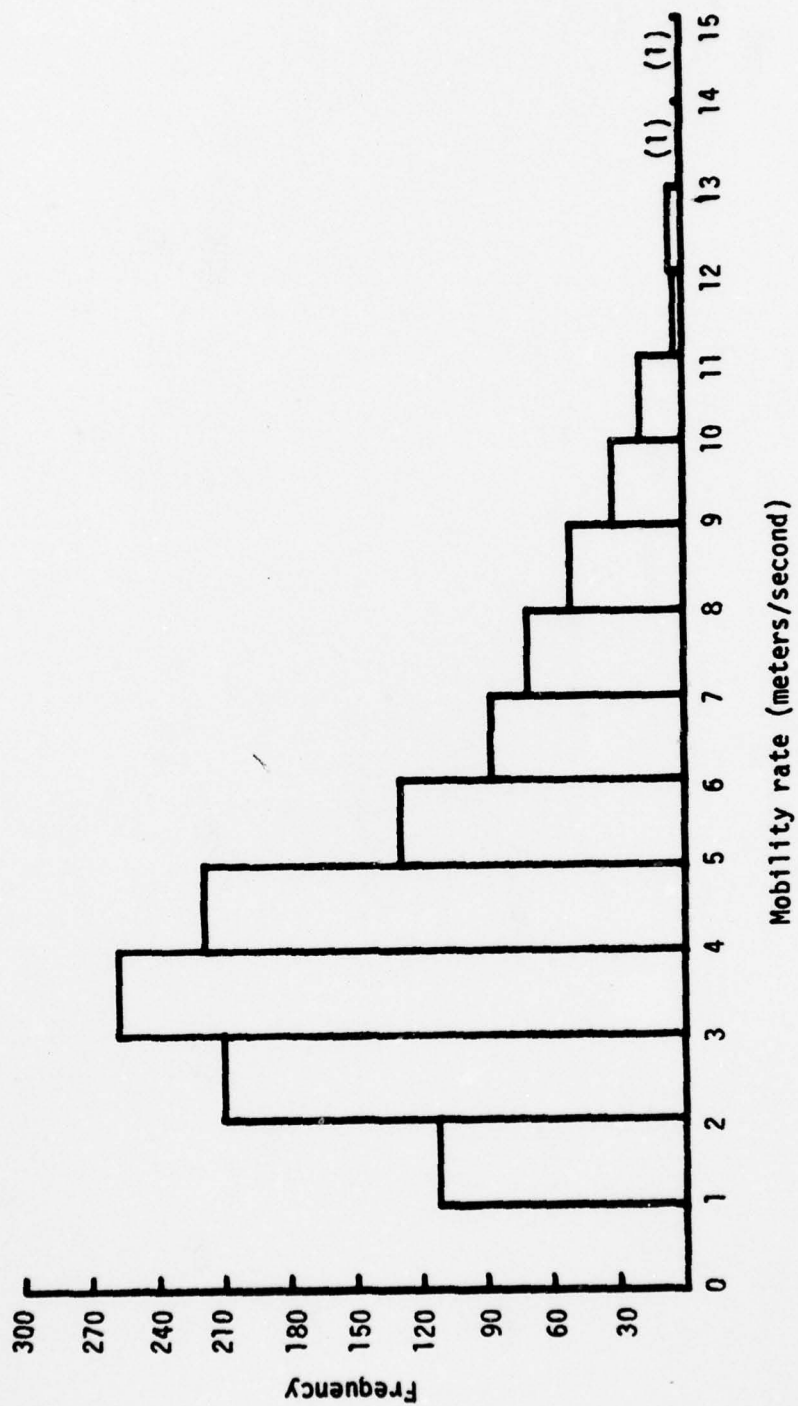
Figure D-2. Histogram plot of active defense event data
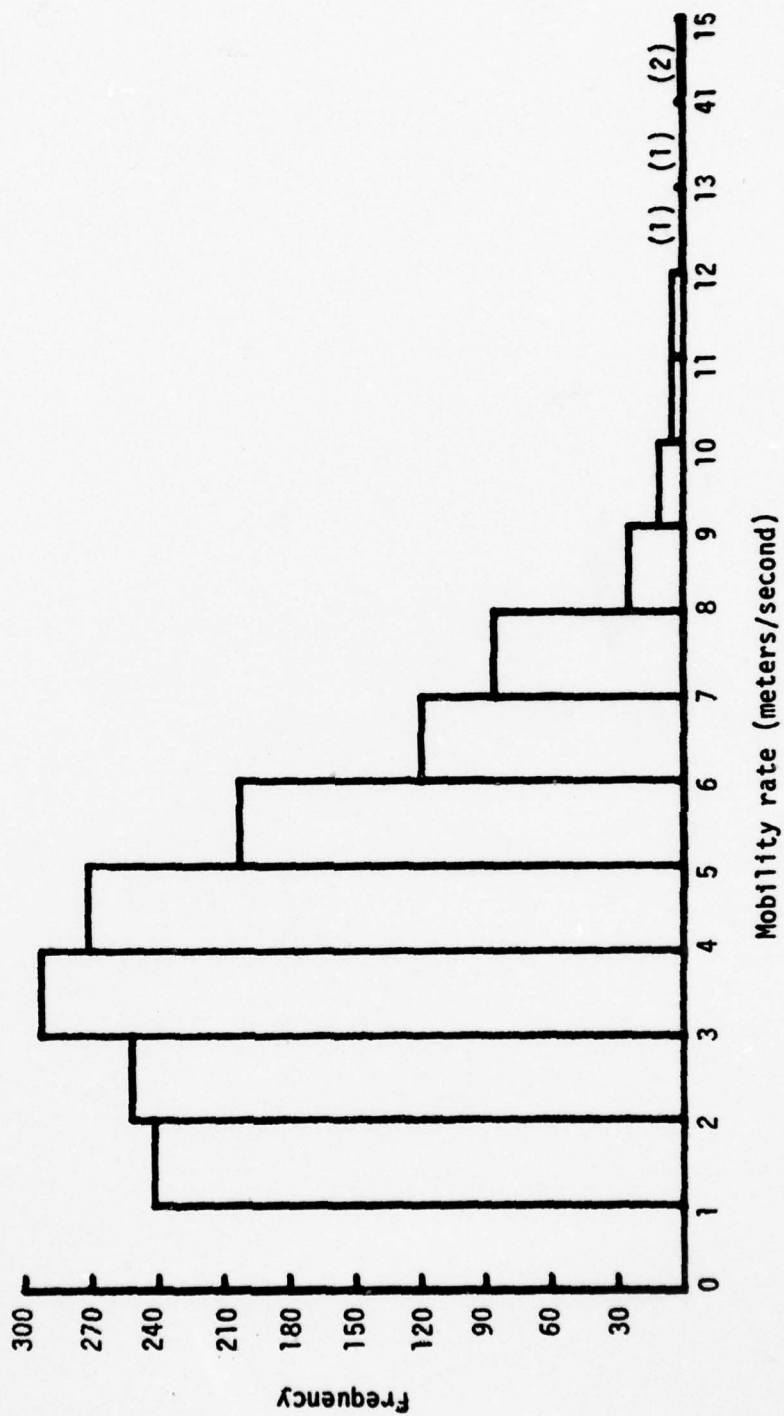
Figure D-3. Histogram plot of movement to contact event data

D-4

APPENDIX E

ANALYSIS OF VARIANCE ON MOBILITY DATA

E-1. The statistical significance of the weapon systems and vegetation/
trafficability categories was tested by means of an analysis of variance
(ANOVA). ANOVA is a statistical technique that separates the variance of
observations into component parts, each of which measures variability
attributable to a specific source. In this analysis the sources are weapon
system, vegetation/trafficability, weapon system - vegetation/trafficability
interaction, and unexplained error variance. ANOVA permits the comparison
of the means of several populations; i.e., the comparison of multiple
sample population means.

E-2. A major assumption of ANOVA is the equality of variance of the com-
ponent parts; this was assumed due to the small ratios of the respective
variances. In each of the analyses, the interaction component was found
significant. (All tests used a .05 level of significance.) This result
was not considered meaningful in this analsis. Nevertheless, a plot of
weapon system means per varying terrain conditions; i.e., vegetation/
trafficability class, is depicted in figures E-1 through E-23 per trial
event (the larger the sample size the tighter the confidence interval).
These plots are presented because a significant interaction component in
ANOVA produces complications when interpreting ANOVA results, especially
when weapon system and/or vegetation/trafficability are also significant
(which was true in the majority of these analyses).

E-3. Ignoring the significant interaction component, an a posteriori least
significant difference test with a .05 level of significance was used to
determine the source of significant means within weapon system (when there
were three types) and/or vegetation/trafficability; i.e., when either weapon
system or vegetation/trafficability exhibited significance. Tables E-1
through E-8 present the results of this analysis. The data from the cells
were pooled (aggregated) where they were not found to be significantly
different, and the resultant means are presented. In viewing these tables,
one will observe that the TOW weapon system, in general, had a significantly
faster mean mobility rate than the tank, irrespective of trial event and
organization.

E-1
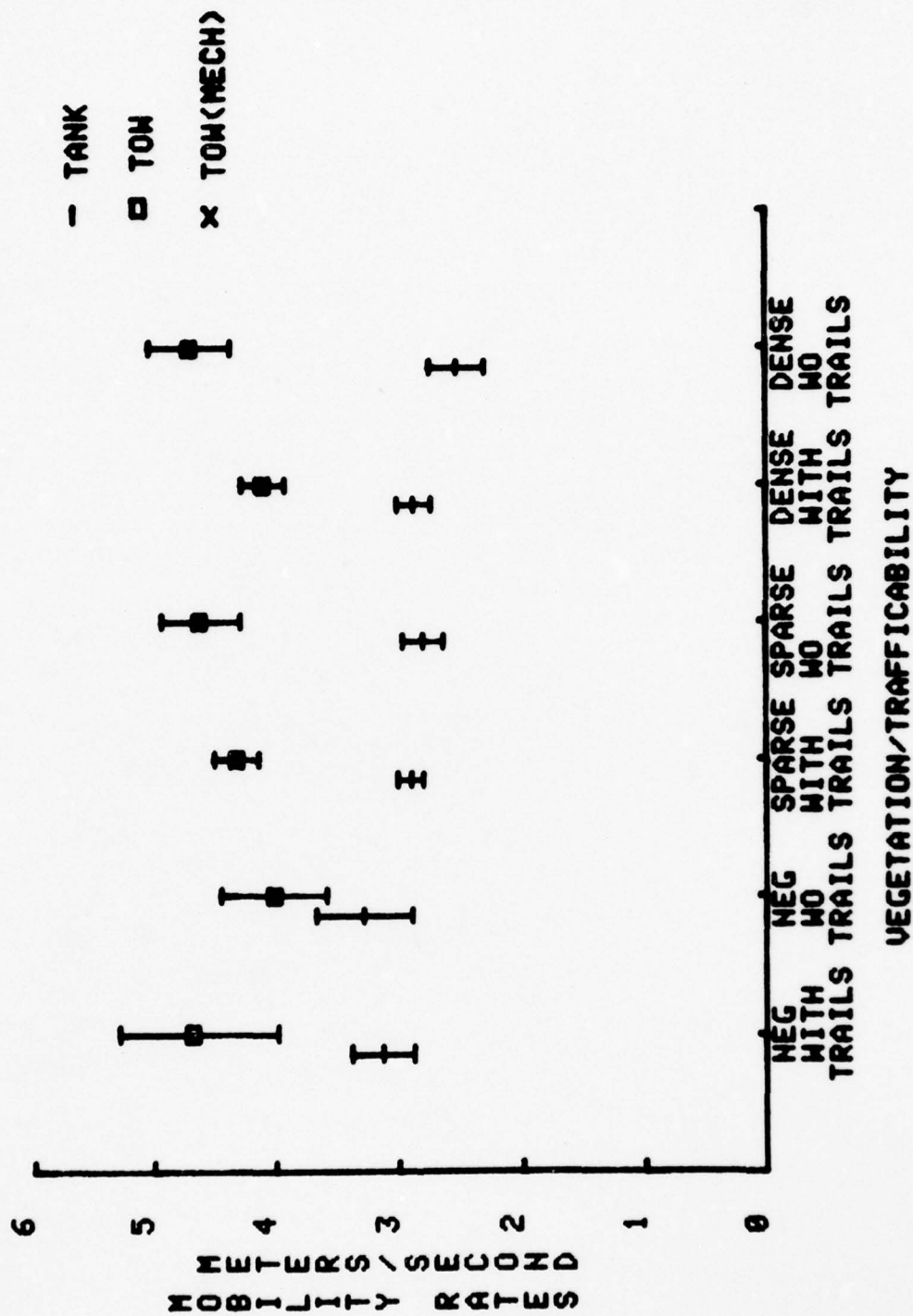
Figure E-1. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 1, movement to contact
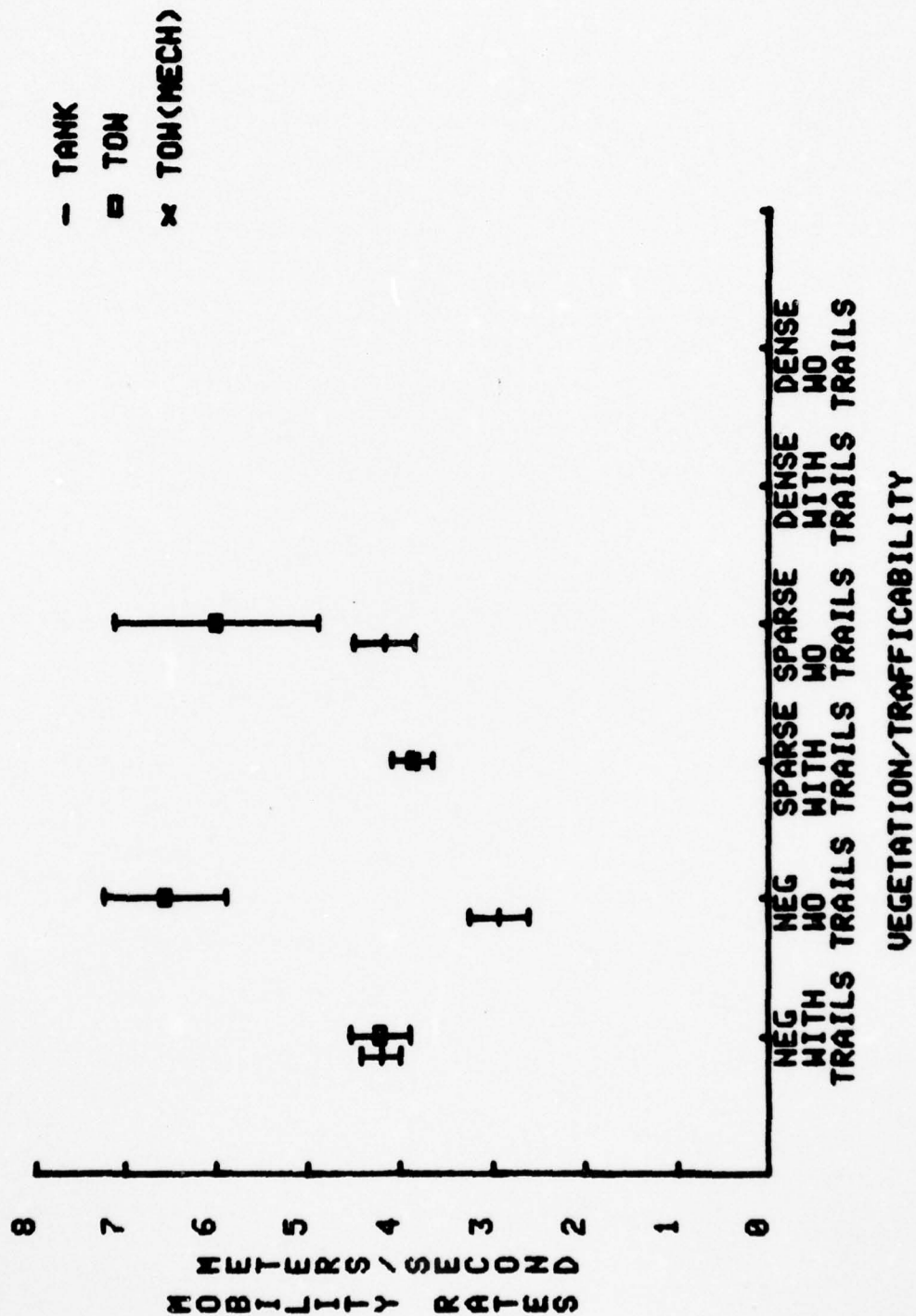
Figure E-2. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 1, active defense

— TANK

□ TOW

✕ TOW(MECH)
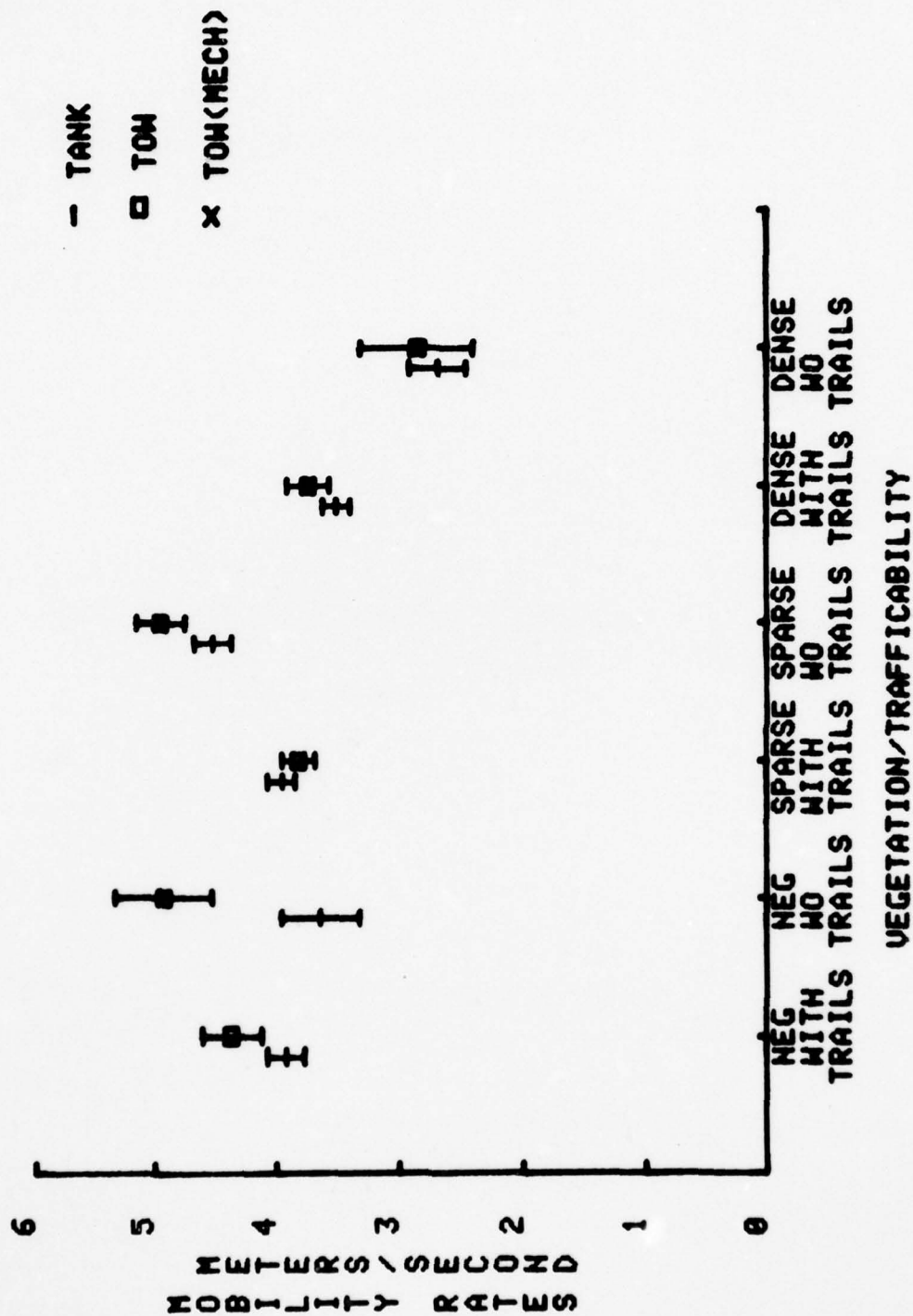
Figure E-3. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 1, deliberate attack

VEGETATION/TRAFFICABILITY

NEG NEG SPARSE SPARSE DENSE DENSE
WITH NO WITH NO WITH NO
TRAILS TRAILS TRAILS TRAILS TRAILS TRAILS

MOBILITY RATE/SECONDS

6 5 4 3 2 1 0
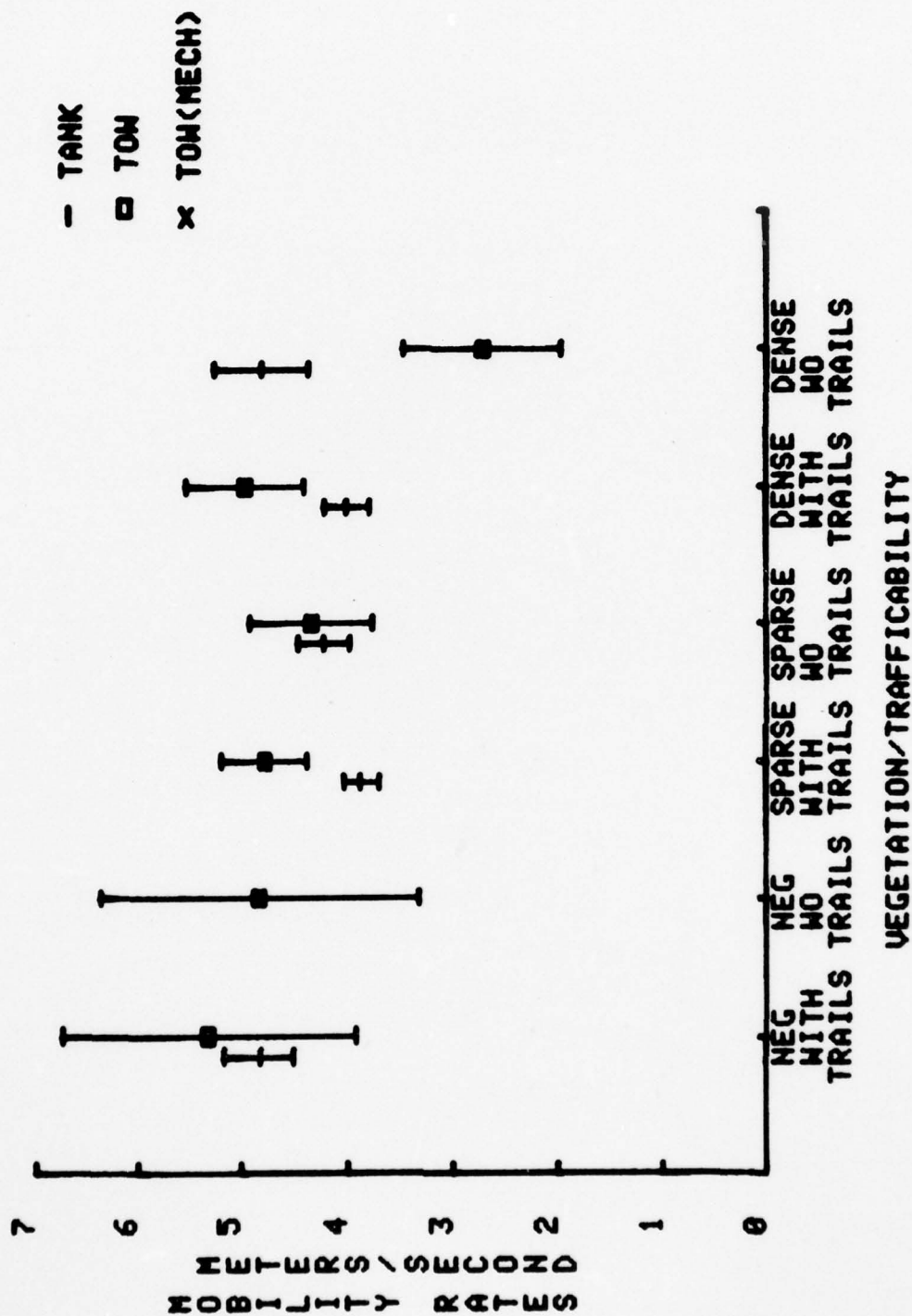
Figure E-4. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 2, movement to contact
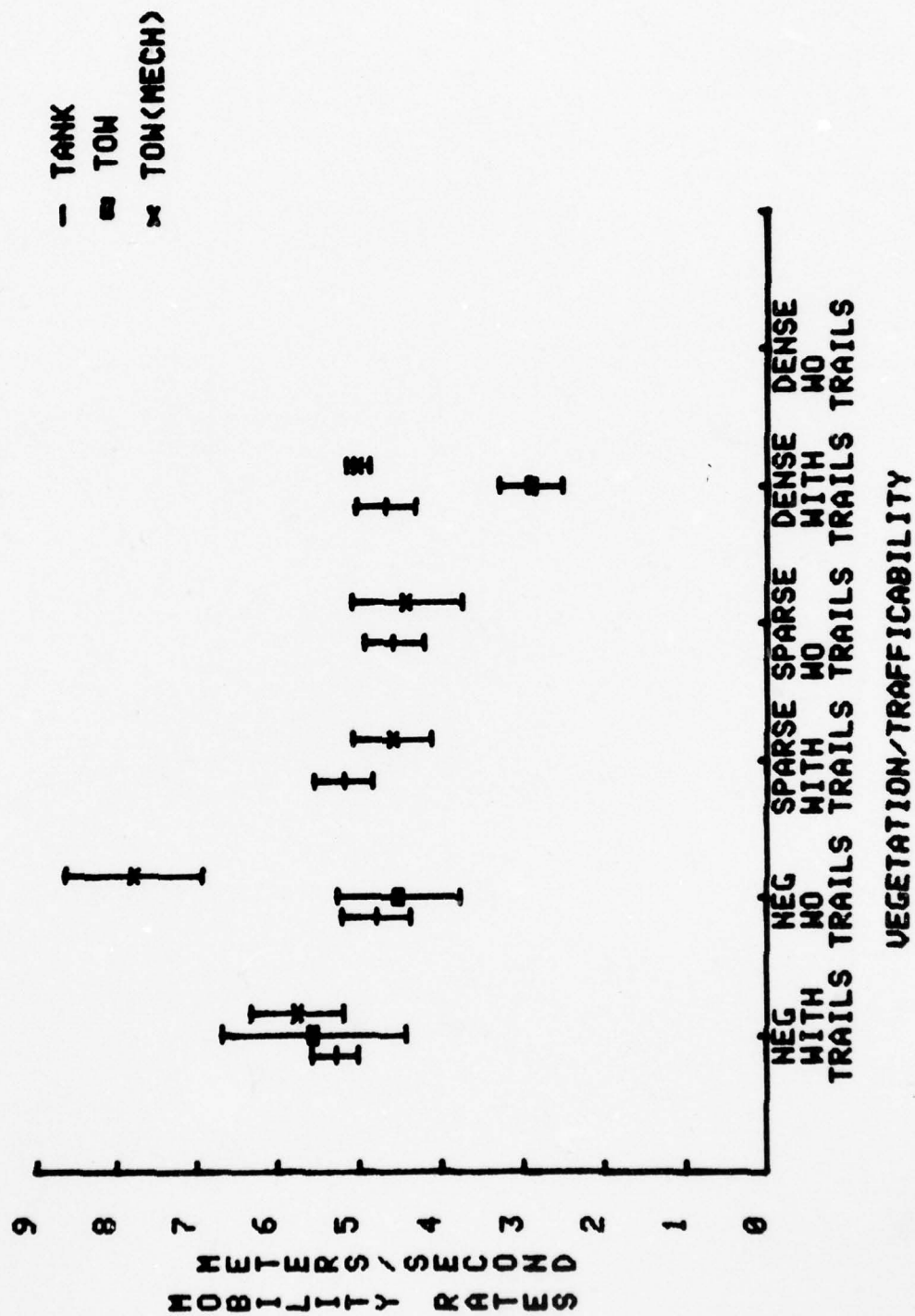
Figure E-5. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 2, active defense
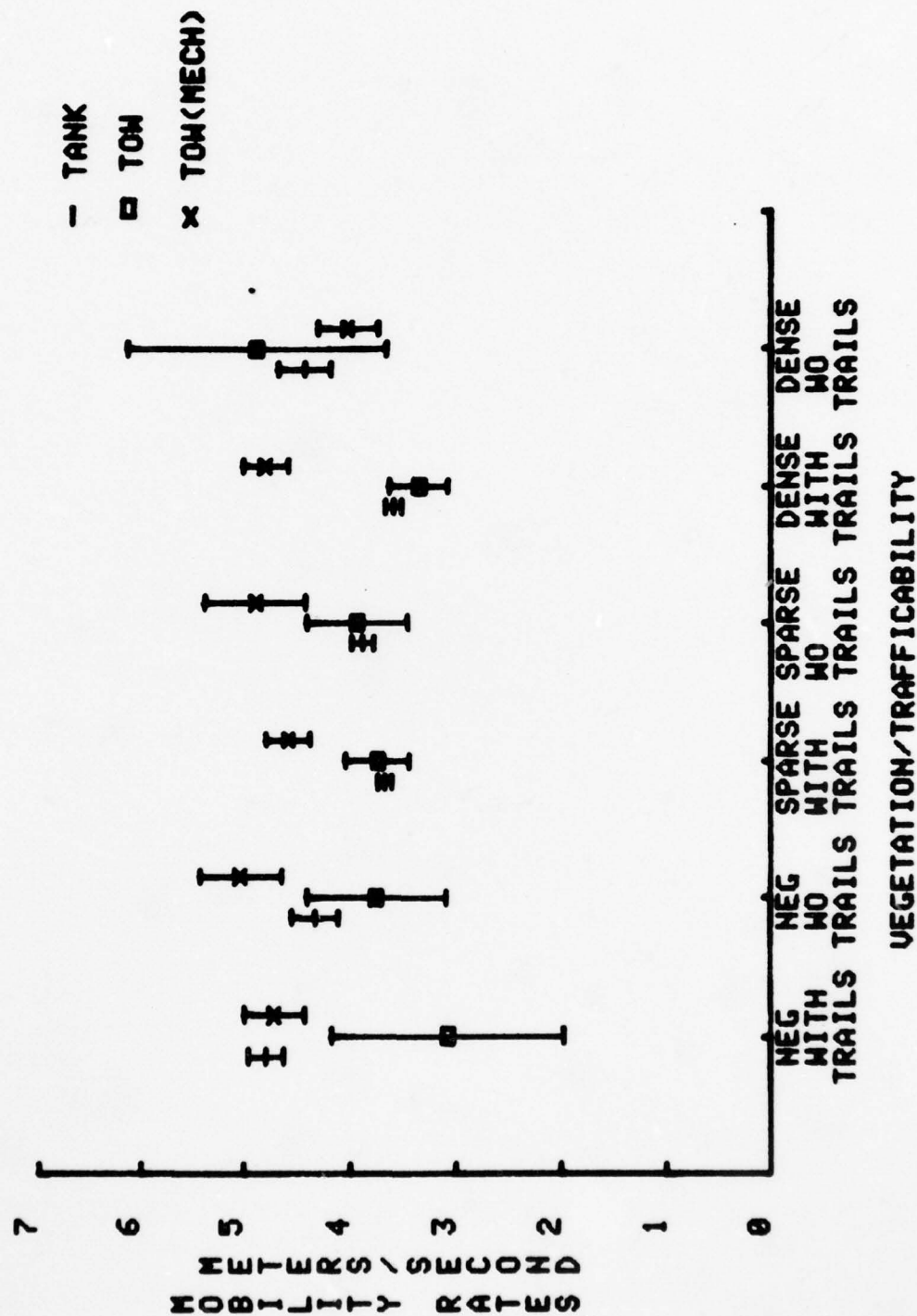
Figure E-6. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions – trial 2, deliberate attack

E-7
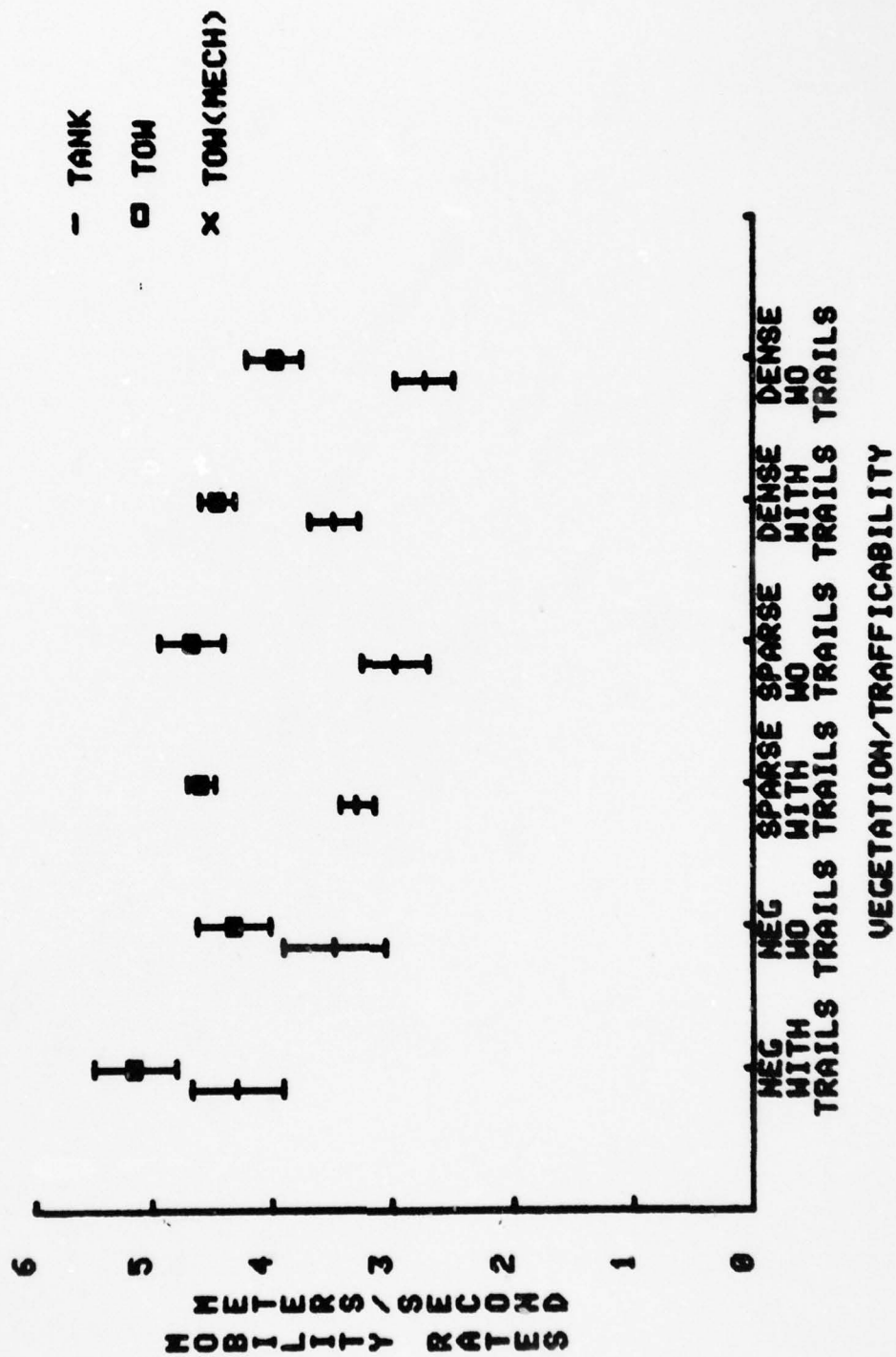
Figure E-7. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 3, movement to contact

E-8

AD
A054830
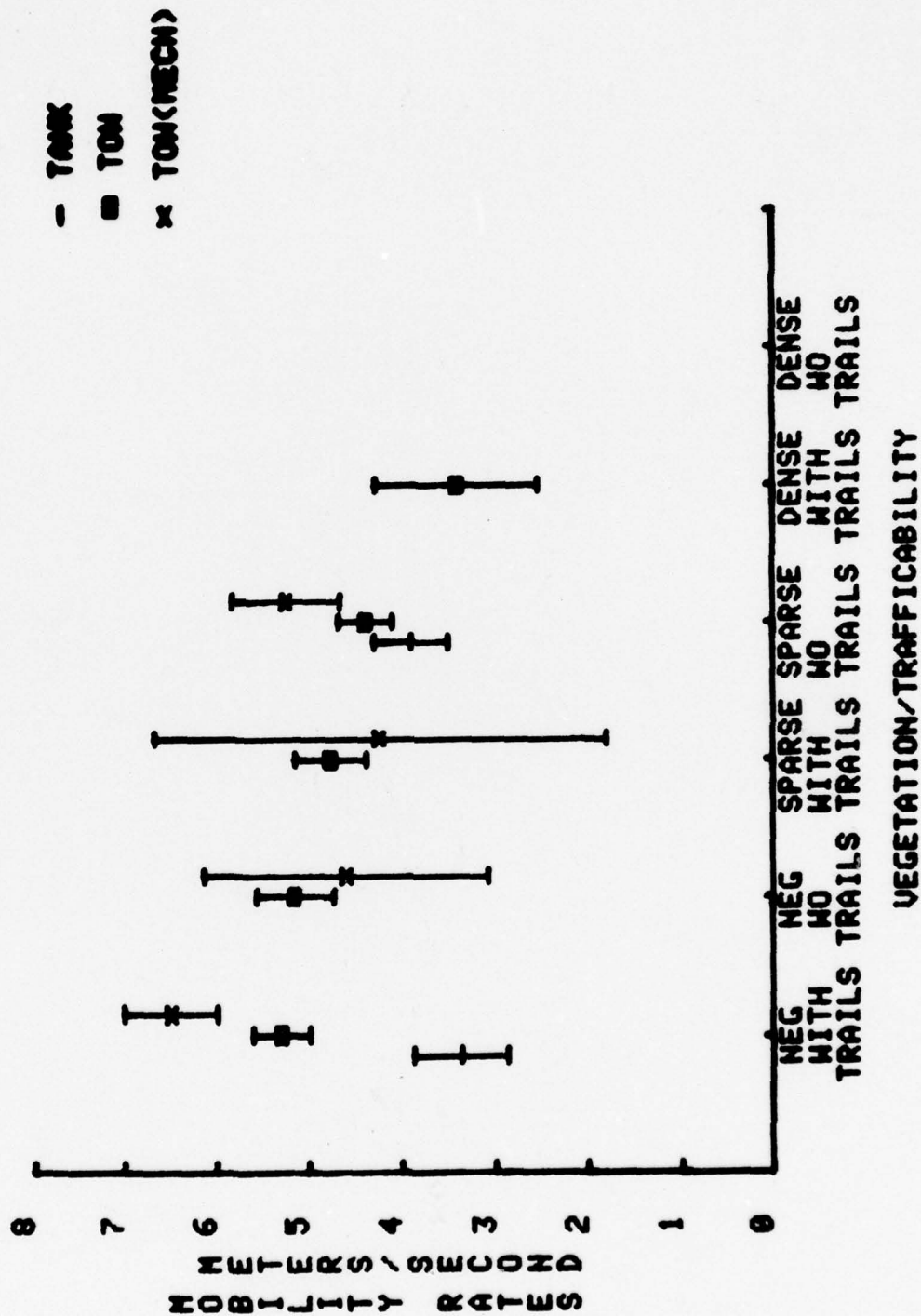
Figure E-8. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 3, active defense
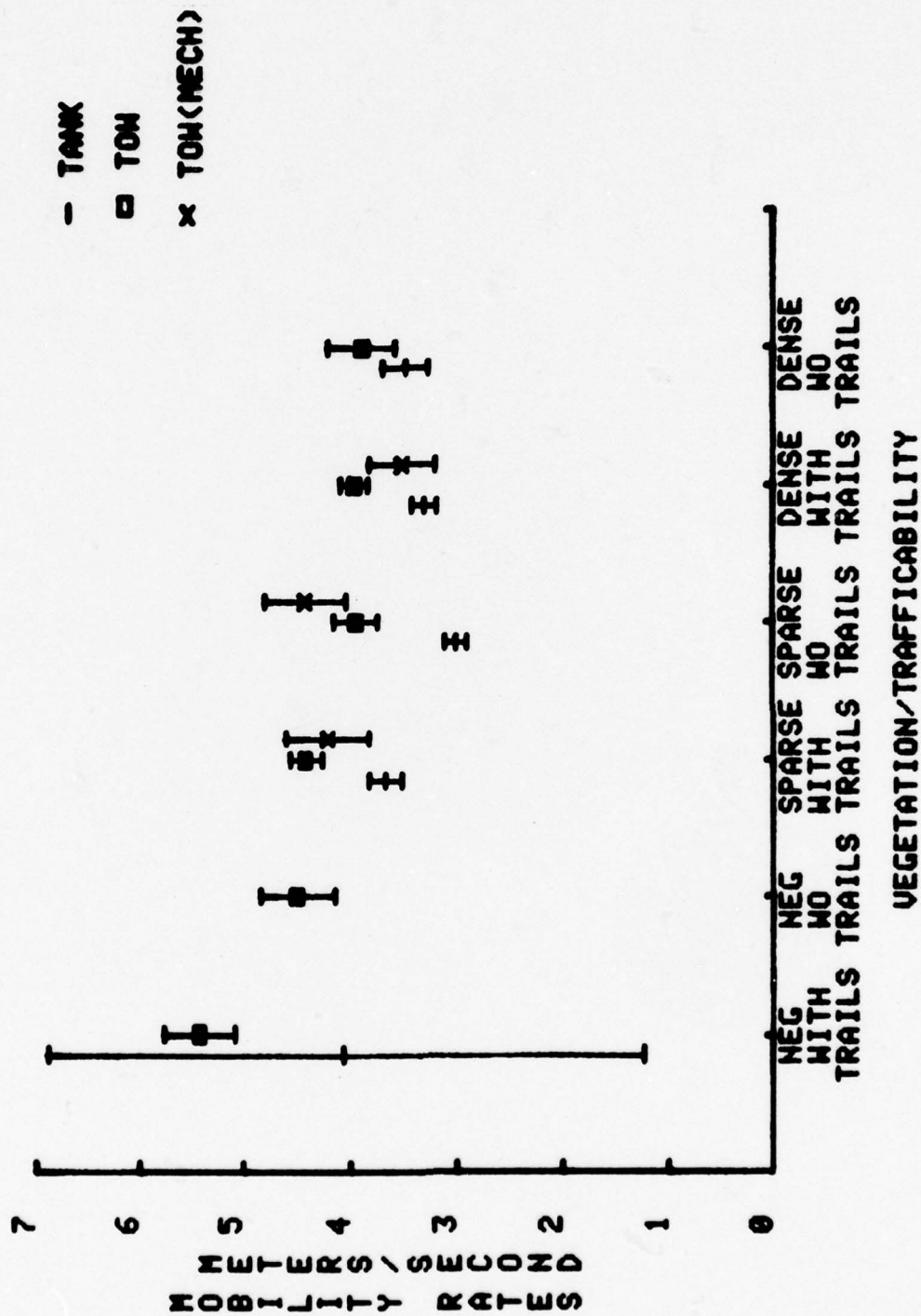
Figure E-9. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 3, deliverate attack
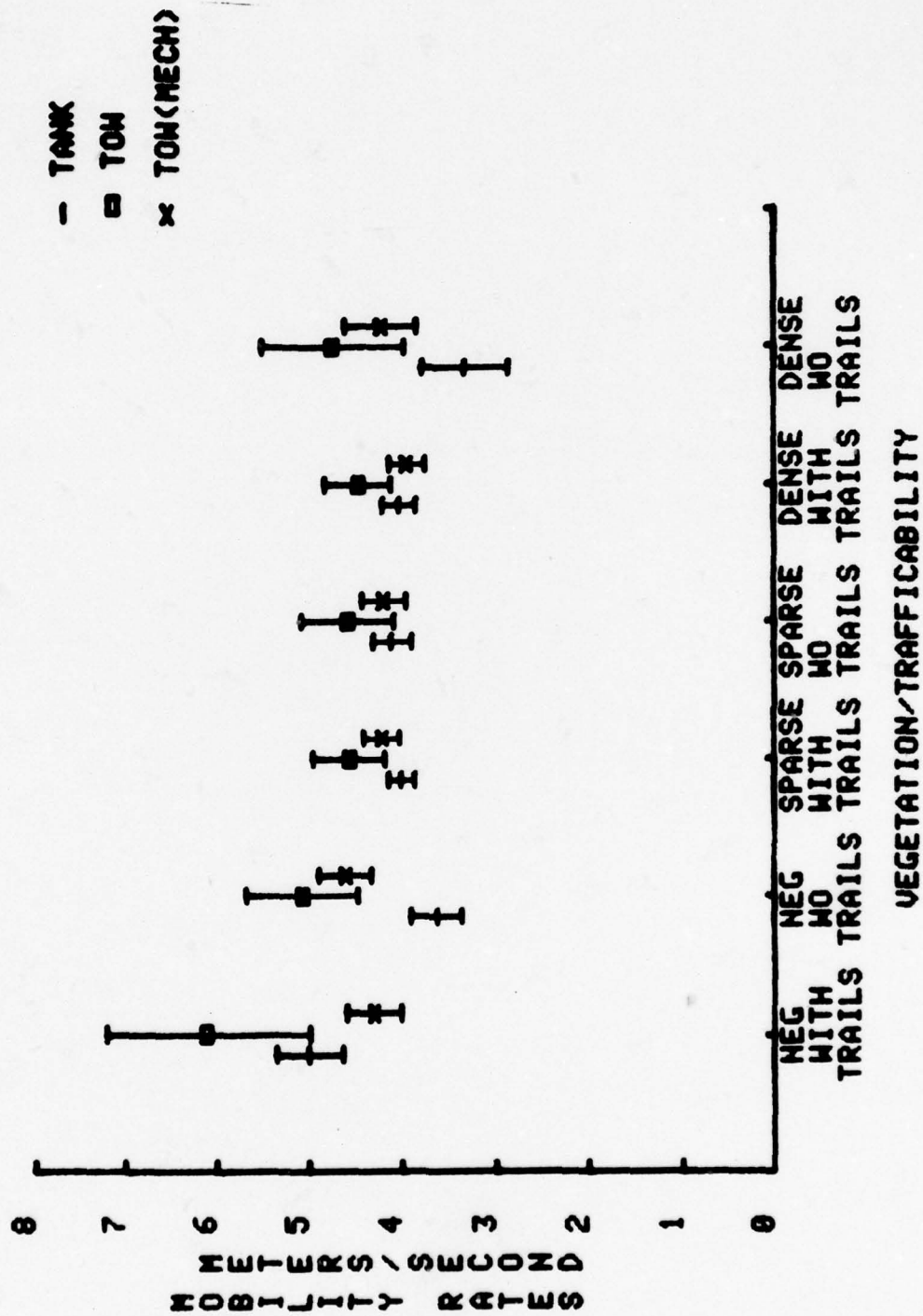
Figure E-10. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 4, movement to contact

E-11
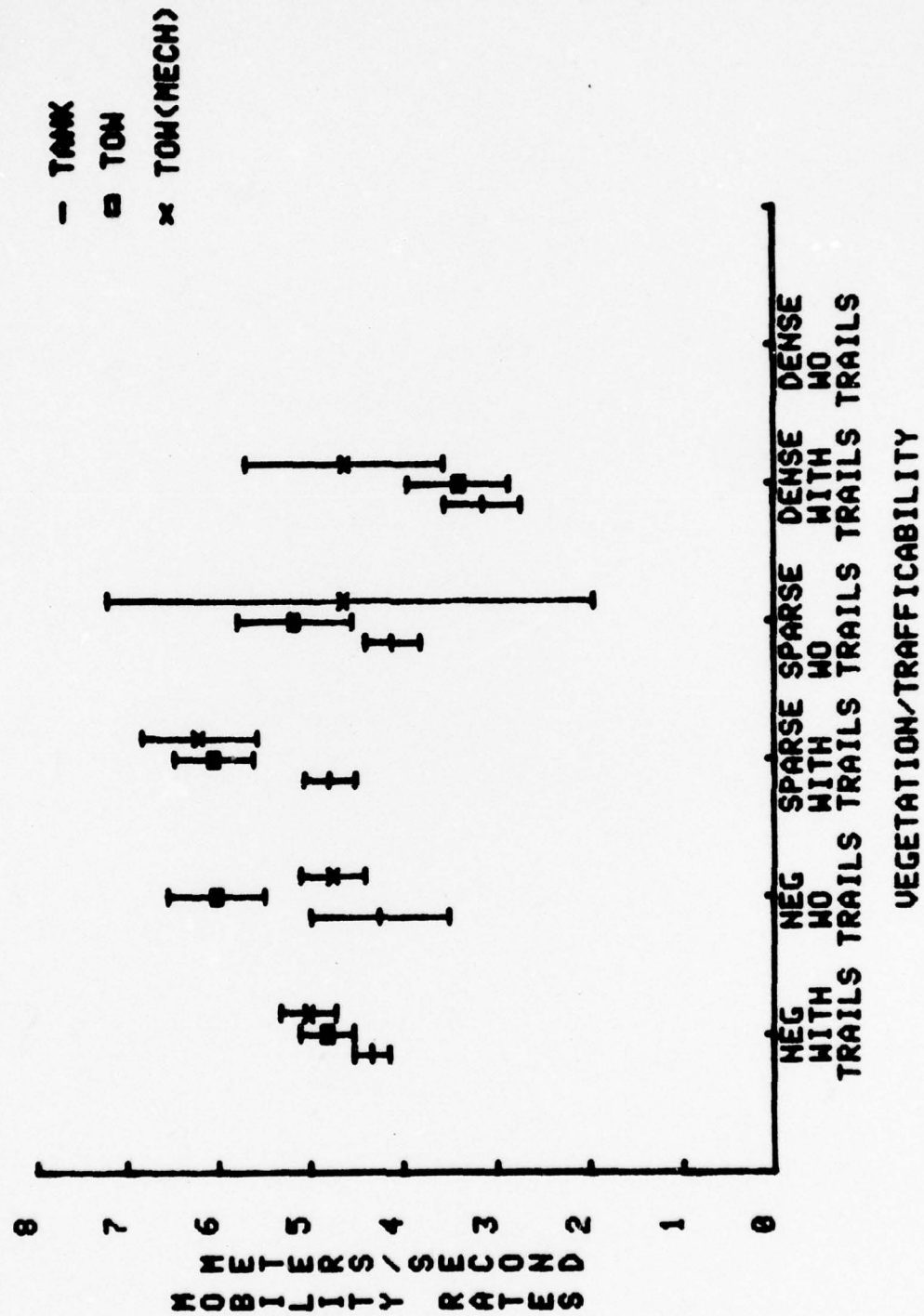
Figure E-11. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions – trial 4, active defense
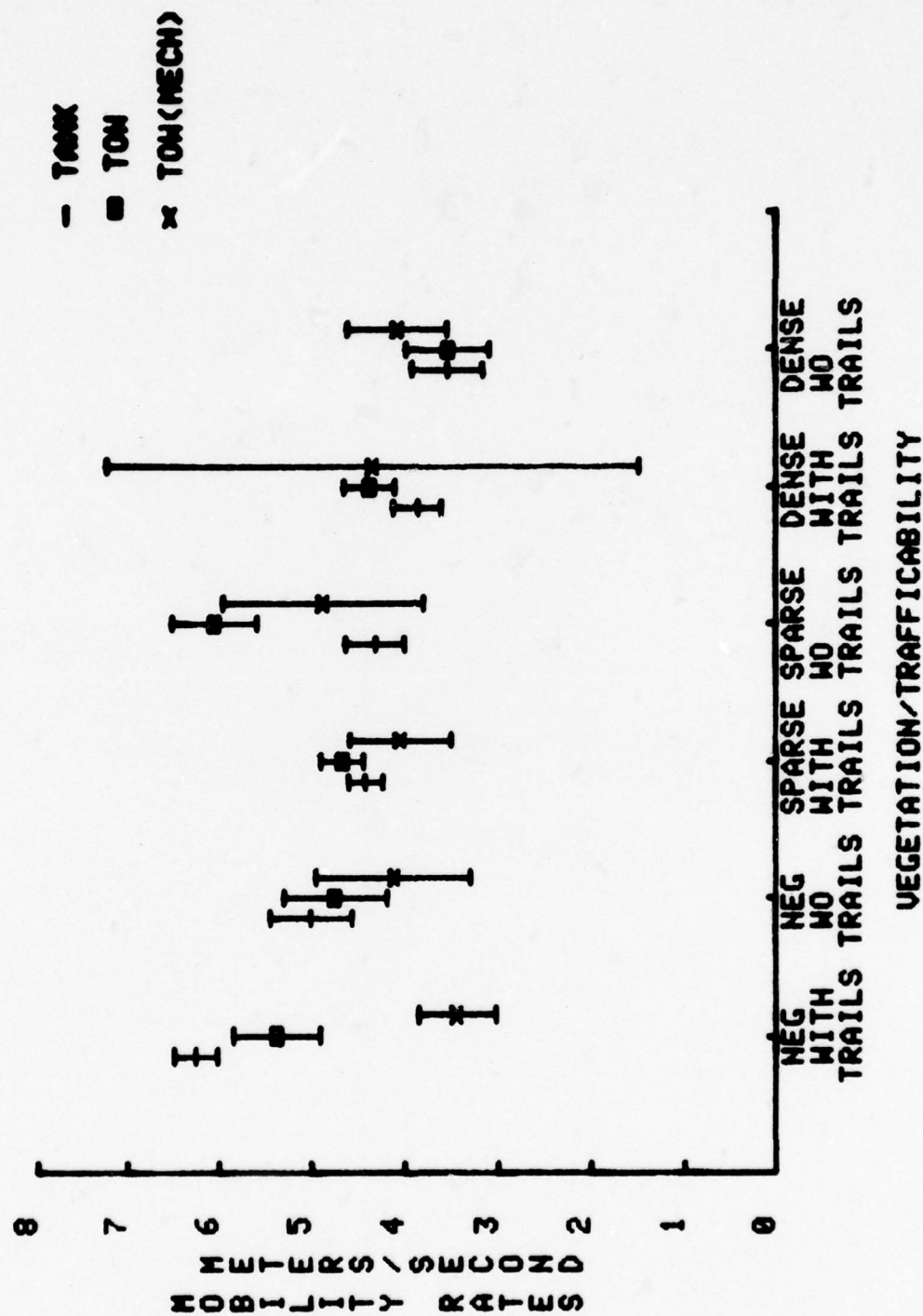
Figure E-12. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 4, deliberate attack

E-13
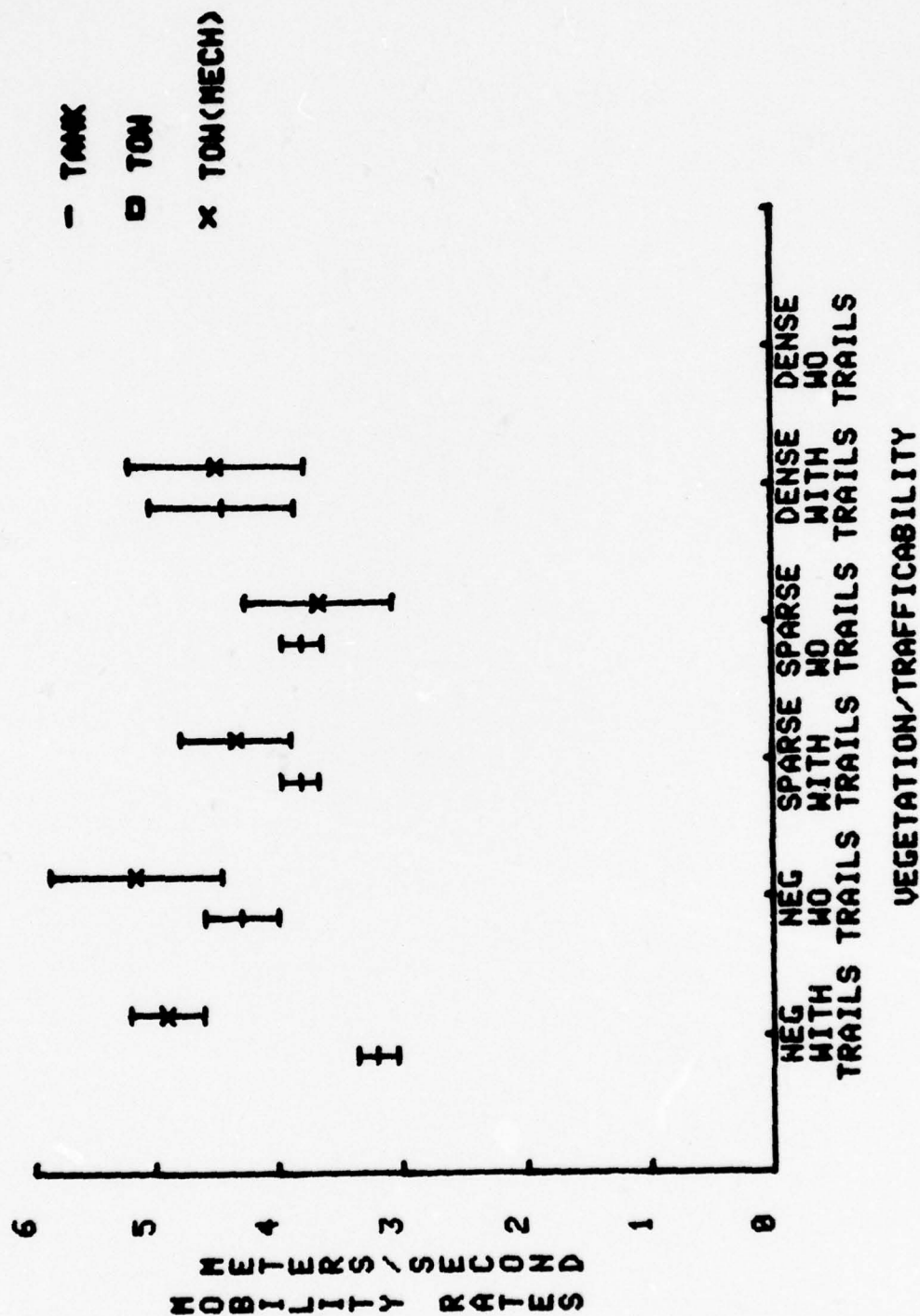
Figure E-13. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 5, active defense
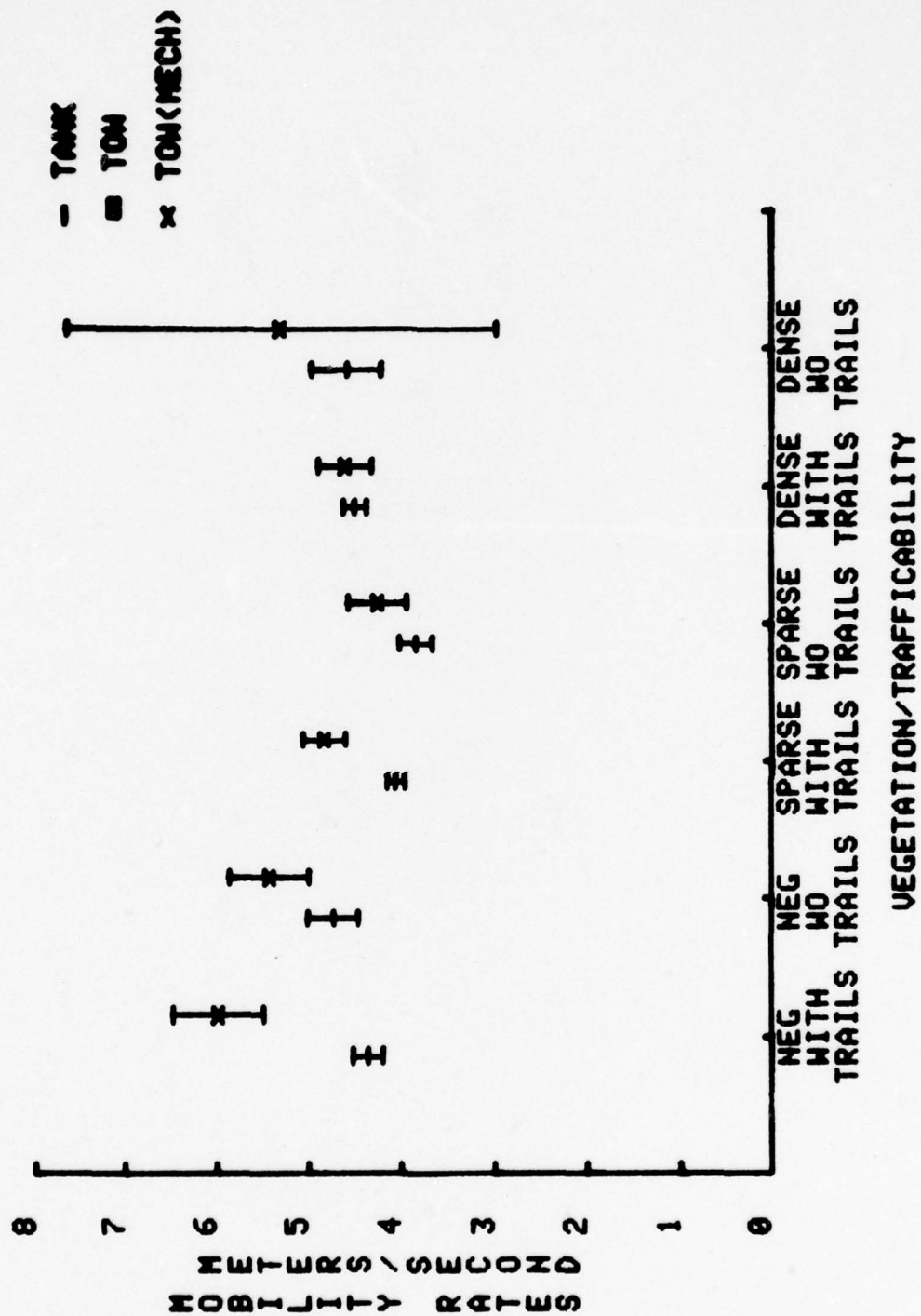
Figure E-14. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 5, deliberate attack

E-15
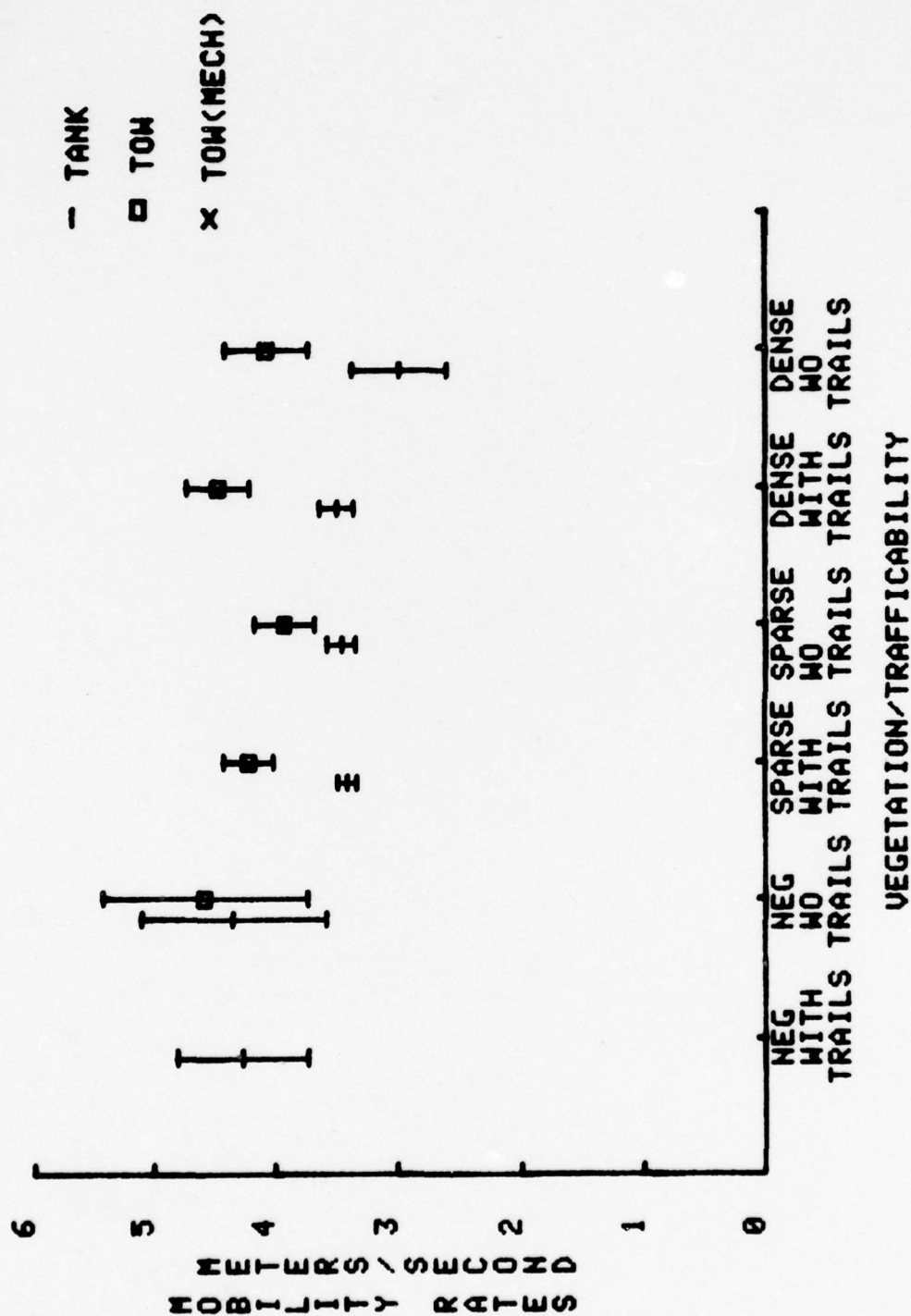
Figure E-15. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 6, movement to contact

E-16
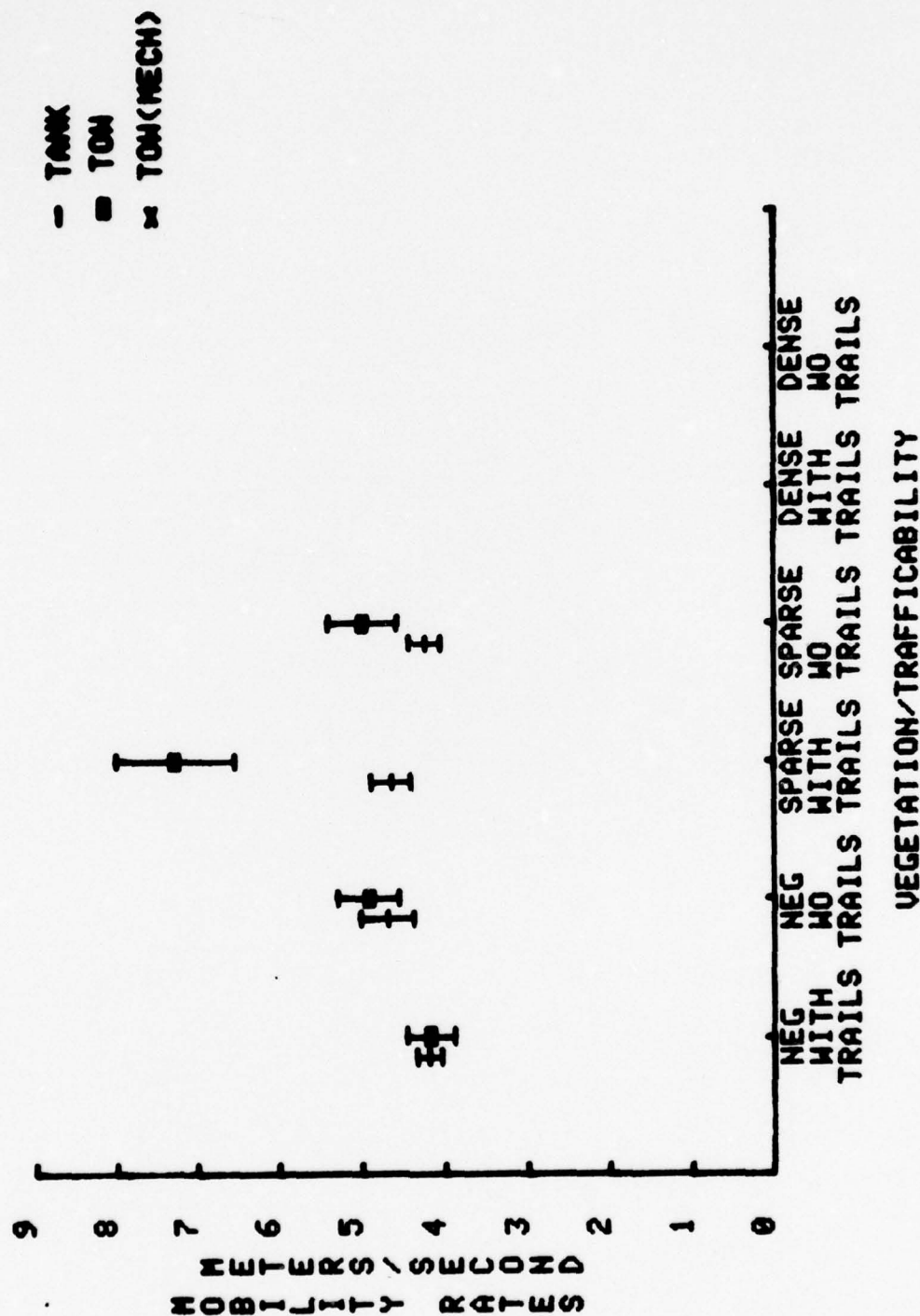
Figure E-16. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 6, active defense
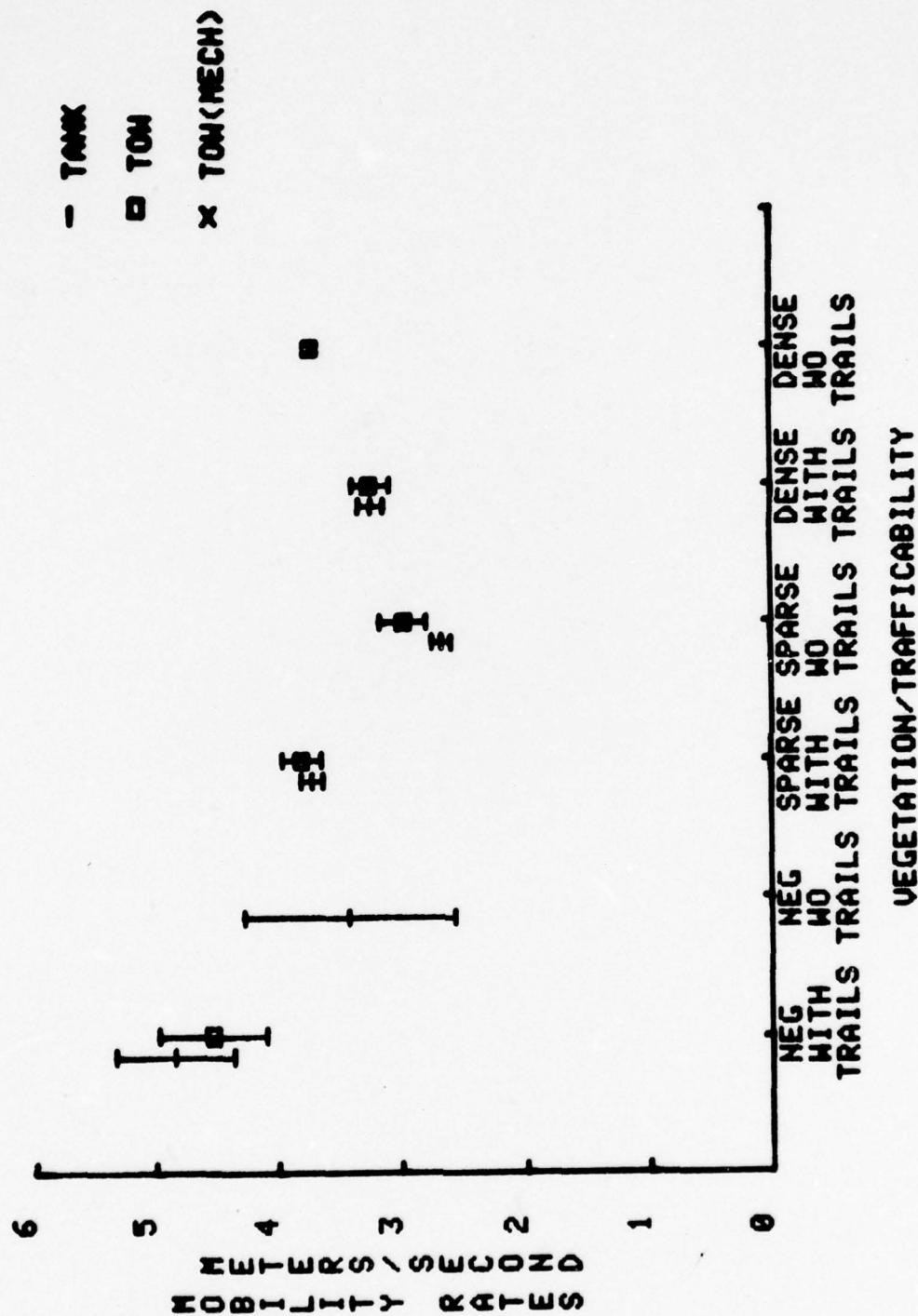
Figure E-17. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 6, deliberate attack

— TANK

■ TOW

× TOW(MECH)

NEG
WITH
TRAILS

NEG
WITH NO
TRAILS

SPARSE
WITH
TRAILS

SPARSE
WITH NO
TRAILS

DENSE
WITH
TRAILS

DENSE
WITH NO
TRAILS

VEGETATION/TRAFFICABILITY

8

7

6

5

4

3

2

1

0

MOBILITY RATES/SEC/N
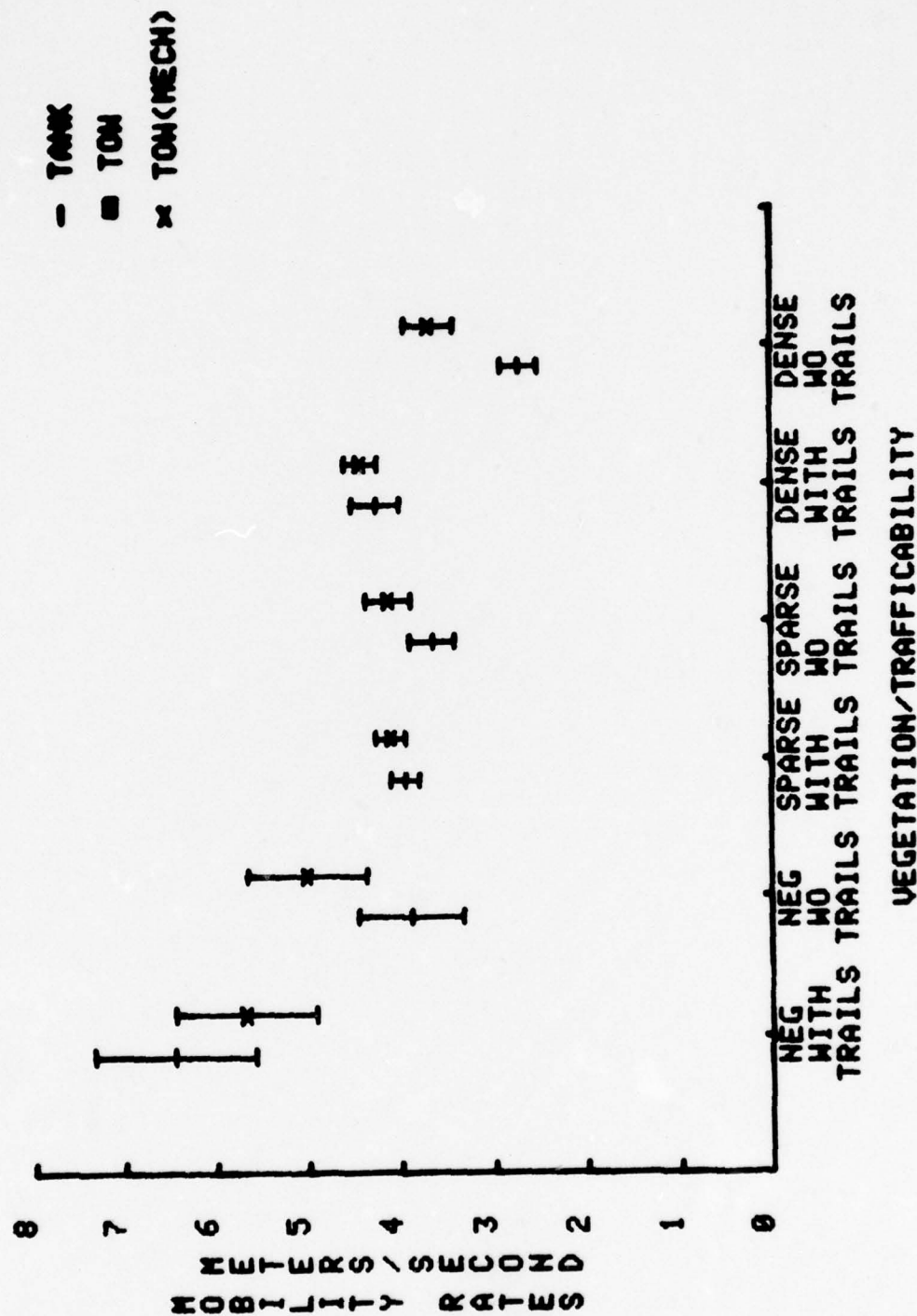
Figure E-18. Mean mobility rates and 95 percent confidence intervals for varying terrain
conditions - trial 7, movement to contact
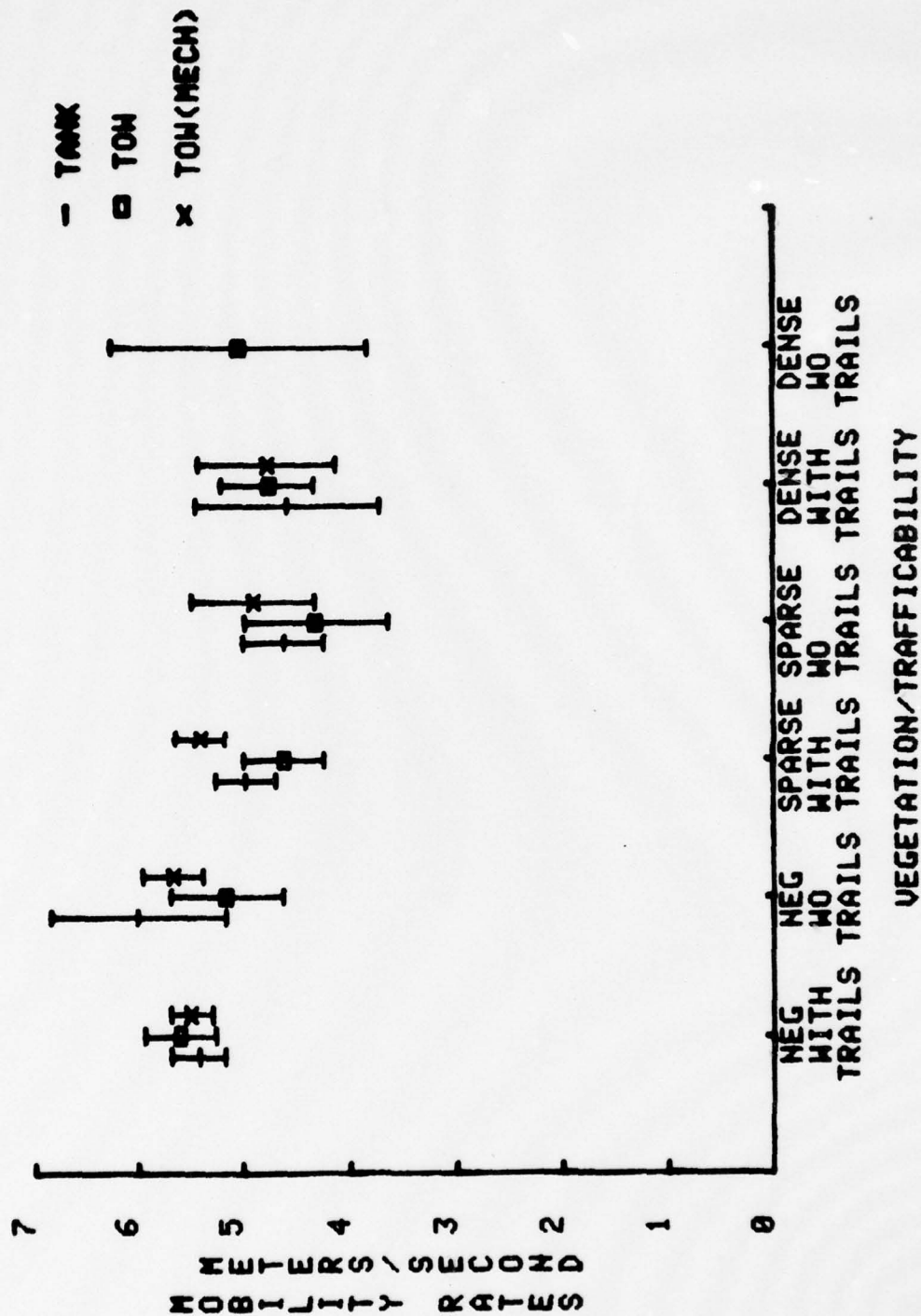
Figure E-19. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 7, active defense
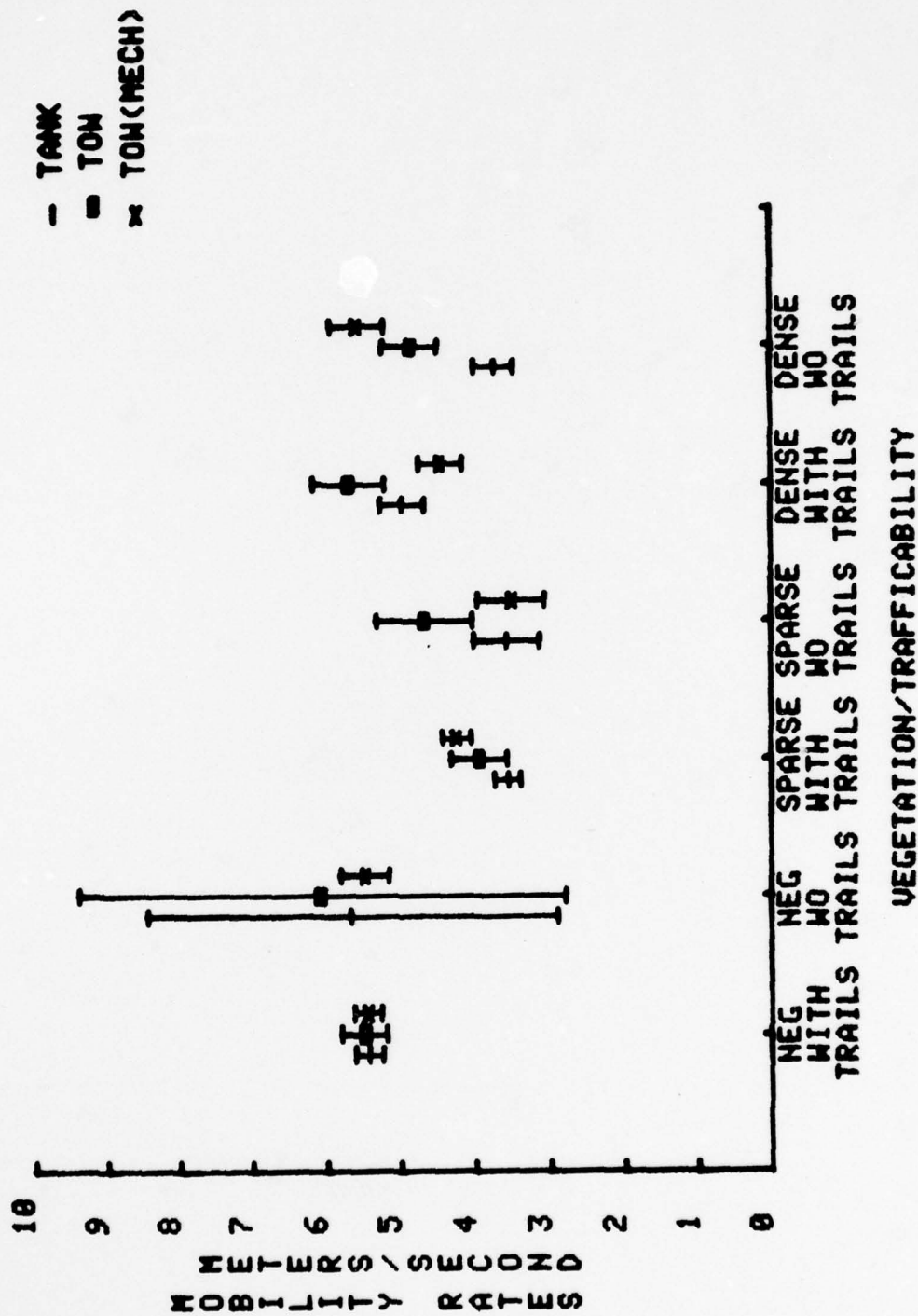
Figure E-20. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 7, deliberate attack
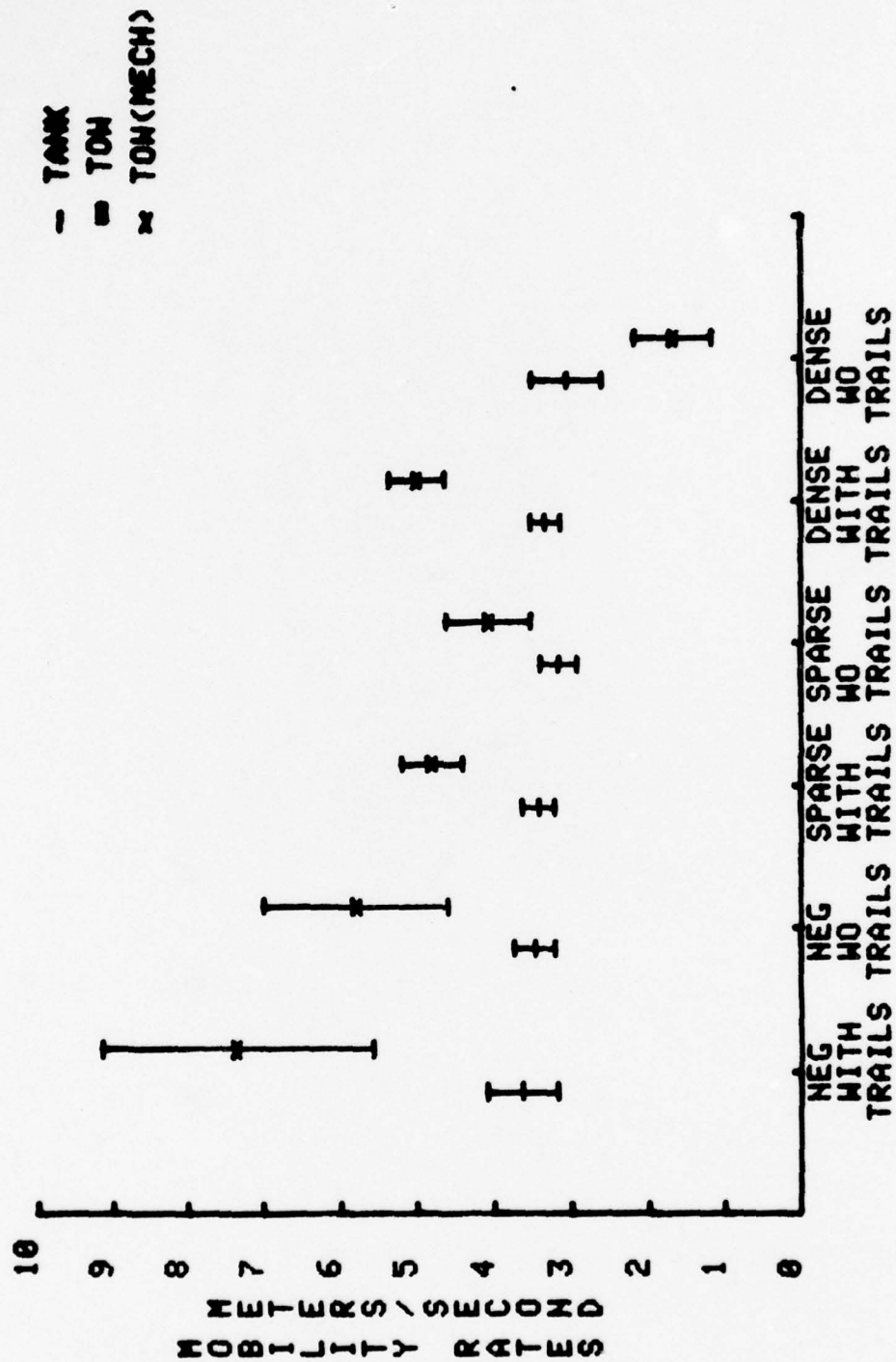
Figure E-21. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 8, movement to contact
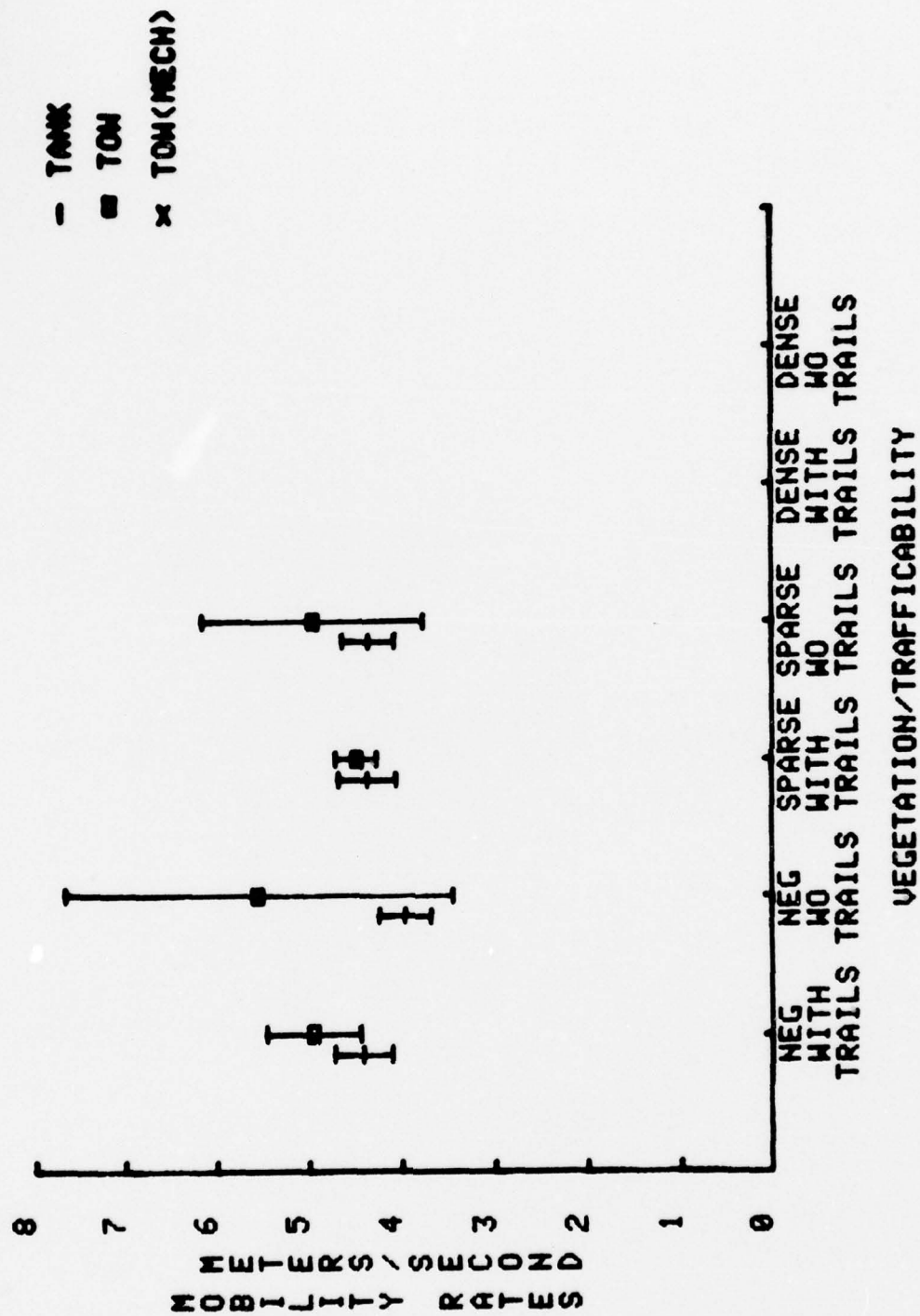
Figure E-22. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 8, active defense
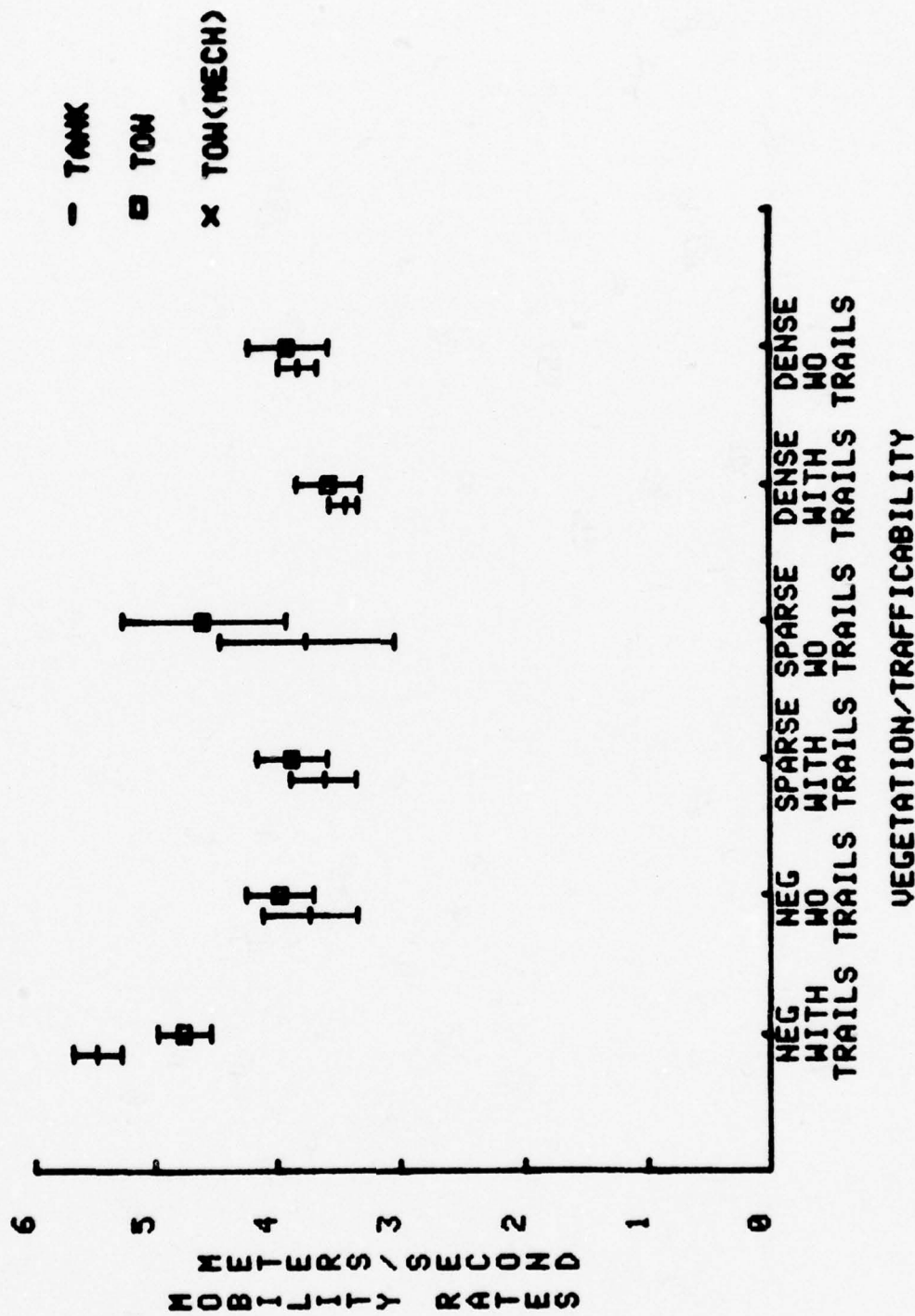
Figure E-23. Mean mobility rates and 95 percent confidence intervals for varying terrain conditions - trial 8, deliberate attack

E-24

Table E-1. Trial 1 (T-Tank) pooled mean mobility rates (meters/second) - results of ANOVA

Vegetation/Trafficability Condition	Event: Movement to Contact — Weapon System			Active Defense — Weapon System			Deliberate Attack — Weapon System		
	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)
Negligible/with trails	2.89	4.33		4.04	4.58		3.97*		
Negligible/w/o trails							4.64	4.94	
Sparse/with trails					3.87		3.97*		
Sparse/without trails				4.17	6.01		4.71		
Dense/with trails							3.59		
Dense/without trails							2.72		

* Denotes resultant mean of pooled data.

E-25

Table E-2. Trial 2 (H-Tank) pooled mean mobility rates (meters/second) – results of ANOVA

Vegetation/Traffic-ability Condition	Event								
	Movement to Contact			Active Defense			Deliberate Attack		
	Weapon System			Weapon System			Weapon System		
	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)
Negligible/with trails	5.05				5.44		4.78^d		4.78^d
Negligible/w/o trails	4.84	4.77			4.75		4.28		5.04
Sparse/with trails	3.86			5.06^a		5.06^a	3.63^e		4.68^f
Sparse/without trails	4.23			4.59^b		4.54^b	3.89		4.89
Dense/with trails	3.99	4.95		4.34^c		4.34^c	3.63^e		4.68^f
Dense/without trails	4.80	2.70					4.42		4.01

a, b, c, d, e, f – Same lettered entries denote resultant mean of pooled data.

E-26

Table E-3. Trial 3 (T-Mech) pooled mean mobility rates (meters/second) - results of ANOVA

Vegetation/Trafficability Condition	Event								
	Movement to Contact			Active Defense			Deliberate Attack		
	Weapon System			Weapon System			Weapon System		
	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)
Negligible/with trails	4.29		5.16	3.37	5.30	6.49	3.66		4.92
Negligible/w/o trails		4.54		4.73		4.50		4.05	4.39
Sparse/with trails	3.31				4.32		3.00		
Sparse/without trails				3.89			3.29	3.89	4.05
Dense/with trails		3.98					3.46	3.86	
Dense/without trails	2.73								

E-27

Table E-4. Trial 4 (H-Mech) pooled mean mobility rates (meters/second) - results of ANOVA

Vegetation/Trafficability Condition	Event								
	Movement to Contact			Active Defense			Deliberate Attack		
	Weapon System			Weapon System			Weapon System		
	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)
Negligible/with trails	4.66[a]	6.10	4.66[a]	4.87	5.31	5.31	6.00	6.00	3.44
Negligible/w/o trails	4.66[a]	6.10	4.66[a]	4.87	5.31	5.31	4.78[c]	4.78[c]	4.34[d]
Sparse/with trails	4.06[b]	4.59	4.06[b]	4.36	5.47	5.47	4.51	4.51	4.04
Sparse/without trails	4.06[b]	4.59	4.06[b]	4.36	5.47	5.47	4.78[c]	4.78[c]	4.34[d]
Dense/with trails				3.39	4.03	4.03	3.87	3.87	4.08
Dense/without trails				3.39	4.03	4.03	3.87	3.87	4.08

a, b, c, d - Same lettered entries denote resultant mean of pooled data.

Table E-5. Trial 5 (H-Tank) pooled mean mobility rates (meters/second) - results of ANOVA

Vegetation/ Trafficability Condition	Movement to Contact Weapon System			Active Defense Weapon System			Deliberate Attack Weapon System		
	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)
Negligible/ with trails				3.60[a]		4.54[b]	4.39[c]		5.95[d]
Negligible/ w/o trails				4.29		5.40	4.74		5.43
Sparse/with trails				3.60[a]		4.54[b]			
Sparse/with-out trails							4.16		4.64
Dense/with trails				4.42		4.47			
Dense/with-out trails							4.39[c]		5.95[d]

a, b, c, d - Same lettered entries denote resultant mean of pooled data.

E-29

Table E-6. Trial 6 (T-Tank) pooled mean mobility rates (meters/second) - results of ANOVA

Vegetation/ Trafficability Condition	Event								
	Movement to Contact			Active Defense			Deliberate Attack		
	Weapon System			Weapon System			Weapon System		
	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)
Negligible/ with trails	4.29	4.58		4.21[a]	4.46[b]		4.84	4.53	
Negligible/ w/o trails									
Sparse/with trails	3.41	4.11		4.66	5.25		3.70	3.79	
Sparse/without trails				4.21[a]	4.46[b]				
Dense/with trails	3.45	4.33					2.94	3.15	
Dense/without trails									

a, b - Same lettered entries denote resultant mean of pooled data.

E-30

Table E-7. Trial 7 (H-Mech) pooled mean mobility rates (meters/second) - results of ANOVA

Vegetation/ Trafficability Condition	Movement to Contact Weapon System			Active Defense Weapon System			Deliberate Attack Weapon System		
	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)
Negligible/ with trails	6.46	5.68		5.46	5.49	5.54	5.43	5.50	5.45
Negligible/ w/o trails				4.97	4.60	5.39	3.56	4.10	4.08
Sparse/with trails	3.98	4.22							
Sparse/without trails				4.59	4.52	4.84	4.42	5.28	4.82
Dense/with trails					5.02				
Dense/without trails	2.72	3.69							

Table E-8. Trial 8 (T-Mech) pooled mean mobility rates (meters/second) - results of ANOVA

Vegetation/ Trafficability Condition	Event								
	Movement to Contact			Active Defense			Deliberate Attack		
	Weapon System			Weapon System			Weapon System		
	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)	Tank	TOW	TOW (Mech)
Negligible/ with trails	3.64	7.36		4.42	4.95		5.59	4.76	
Negligible/ w/o trails				3.97	5.56				
Sparse/with trails	3.36	4.78							
Sparse/with-out trails				4.35	4.52		3.60	3.88	
Dense/with trails									
Dense/with-out trails	3.06	1.68							

E-32

APPENDIX F

DECILE VALUES OF MOBILITY DATA

This appendix contains tables depicting decile values for the movement to contact, active defense, and deliberate attack events for the eight test trials. These deciles divide the ordered data into 10 equally numbered samples (the sample sizes will vary if the total sample size is odd). The entries in tables F-1 through F-34 are the median for each decile and the decile value D_i, which is the maximum value in the ith decile.

Table F-1. Trials 1, 2 (T-, H-Tank) tank mobility rate decile values (meters/second) - movement to contact

Decile sample size	Organization			
	T-Series		H-Series	
	200		124	
i	Median	D_i	Median	D_i
1	1.23	1.43	1.18	1.52
2	1.60	1.76	1.53	2.26
3	1.90	2.00	2.54	2.82
4	2.13	2.25	3.08	3.31
5	2.40	2.55	3.59	3.81
6	2.69	2.84	4.04	4.31
7	3.00	3.18	4.53	4.90
8	3.45	3.77	5.27	5.62
9	4.19	4.75	6.00	6.60
10	5.66	21.13	7.39	20.18

Table F-2. Trials 1, 2 (T-, H-Tank) tank mobility rate decile values (meters/second) - active defense

Decile sample size	Organization			
	T-Series		H-Series *	
	51		115	
i	Median	D_i	Median	D_i
1	1.71	1.90	1.30	1.79
2	2.10	2.40	2.30	2.70
3	2.72	2.93	3.04	3.38
4	3.06	3.21	3.71	4.05
5	3.44	3.67	4.31	4.57
6	3.89	4.09	4.84	5.13
7	4.36	4.69	5.41	5.70
8	5.04	5.42	6.00	6.37
9	5.74	6.59	6.88	7.30
10	7.79	14.51	7.97	16.60

* H-series data initially supplied by TCATA were inadvertently destroyed; these data were generated from the updated smoothed data that was subsequently provided by TCATA.

Table F-3.   Trials 1, 2 (T-, H-Tank) tank mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	T-Series		. H-Series	
	324		735	
i	Median	D_i	Median	D_i
1	1.41	1.77	1.34	1.65
2	2.03	2.27	2.00	2.50
3	2.50	2.69	2.50	2.73
4	2.88	3.07	2.92	3.13
5	3.25	3.49	3.33	3.54
6	3.73	3.97	3.78	4.02
7	4.24	4.54	4.28	4.55
8	4.87	5.19	4.89	5.25
9	5.66	6.29	5.74	6.34
10	7.13	34.43	7.28	37.54

Table F-4. Trials 1, 2 (T-, H-Tank) TOW mobility rate decile values (meters/second) - movement to contact

Decile sample size	Organization			
	T-Series		H-Series	
	188		28	
i	Median	D_i	Median	D_i
1	1.20	1.54	1.38	1.68
2	1.95	2.24	1.95	2.30
3	2.55	2.86	2.74	3.09
4	3.16	3.38	3.47	3.87
5	3.69	3.97	4.11	4.40
6	4.30	4.63	4.69	4.99
7	4.95	5.33	5.46	5.77
8	5.71	6.14	6.13	6.56
9	6.65	7.36	7.09	7.74
10	8.28	27.65	8.86	13.10

Table F-5. Trials 1, 2 (T-, H-Tank) TOW mobility rate decile values
(meters/second) - active defense

Decile sample size	Organization			
	T-Series		. H-Series *	
	38		5	
i	Median	D_i	Median	D_i
1	1.77	2.12	1.80	2.04
2	2.25	2.55	2.53	2.71
3	2.82	3.08	3.41	3.94
4	3.34	3.52	4.25	4.36
5	3.70	4.01	4.69	4.88
6	4.15	4.37	5.15	5.68
7	4.61	4.88	5.90	6.30
8	5.27	6.03	6.76	7.40
9	6.40	7.33	7.54	7.72
10	8.44	11.05	8.33	9.67

* H-series data initially supplied by TCATA were inadvertently
destroyed; these data were generated from the updated
smoothed data that was subsequently provided by TCATA.

F-6

Table F-6. Trials 1, 2 (T-, H-Tank) TOW mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	T-Series		H-Series	
	220		33	
i	Median	D_i	Median	D_i
1	1.31	1.61	1.25	1.68
2	1.87	2.07	1.93	2.18
3	2.35	2.60	2.36	2.56
4	2.89	3.16	2.73	2.88
5	3.45	3.72	3.17	3.43
6	4.05	4.36	3.67	3.94
7	4.37	5.03	4.22	4.46
8	5.39	5.80	4.73	5.07
9	6.34	6.99	5.40	5.88
10	8.05	17.32	6.52	9.00

Table F-7. Trials 1, 2 (T-, H-Tank) TOW (Mech) mobility rate
decile values (meters/second) - active defense

Decile sample size	Organization			
	T-Series		H-Series*	
			28	
i	Median	D_i	Median	D_i
1			1.31	1.63
2			2.21	2.41
3			2.60	3.03
4			3.36	3.67
5			4.00	4.39
6			4.84	5.19
7			5.79	6.08
8			6.51	6.76
9			8.13	8.82
10			10.08	19.19

* H-series data initially supplied by TCATA were inadvertently
destroyed; these data were generated from the updated
smoothed data that was subsequently provided by TCATA.

Table F-8. Trials 1, 2 (T-, H-Tank) TOW (Mech) mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	T-Series		H-Series	
			131	
i	Median	D_j	Median	D_j
1			1.49	2.12
2			2.53	2.78
3			3.08	3.35
4			3.61	3.85
5			4.15	4.44
6			4.76	5.03
7			5.36	5.66
8			6.03	6.47
9			6.96	7.54
10			8.42	13.09

Table F-9. Trials 3, 4 (T-, H-Mech) tank mobility rate decile values (meters/second) - movement to contact

	Organization			
	T-Series		H-Series	
Decile sample size	117		217	
i	Median	D_i	Median	D_i
1	1.31	1.55	1.32	1.67
2	1.75	1.94	2.00	2.25
3	2.16	2.33	2.46	2.71
4	2.53	2.69	2.95	3.16
5	2.89	3.08	3.38	3.63
6	3.25	3.45	3.91	4.22
7	3.65	3.89	4.55	4.95
8	4.14	4.47	5.30	5.77
9	4.88	5.33	6.26	6.98
10	6.04	18.34	7.92	18.48

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Table F-10. Trials 3, 4 (T-, H-Mech) tank mobility rate decile
values (meters/second) - active defense

Decile sample size	Organization			
	T-Series		H-Series	
	15		83	
i	Median	D_i	Median	D_i
1	1.68	1.84	1.77	2.06
2	1.95	2.10	2.42	2.81
3	2.25	2.75	3.15	3.49
4	2.86	2.92	3.84	4.05
5	3.25	3.37	4.27	4.59
6	3.53	3.77	4.85	5.10
7	3.96	4.08	5.41	5.72
8	4.49	5.00	6.04	6.32
9	5.60	6.28	6.88	7.38
10	6.94	15.62	7.99	11.46

Table F-11. Trials 3, 4 (T-, H-Mech) tank mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	T-Series		H-Series	
	211		177	
i	Median	D_i	Median	D_i
1	1.32	1.52	1.36	1.67
2	1.76	1.94	1.94	2.26
3	2.10	2.24	2.55	2.83
4	2.41	2.60	3.10	3.46
5	2.81	2.98	3.77	4.16
6	3.17	3.40	4.60	5.04
7	3.65	3.89	5.46	5.88
8	4.25	4.64	6.37	6.87
9	5.07	5.54	7.34	7.90
10	6.23	14.32	8.87	21.40

Table F-12. Trials 3, 4 (T-, H-Mech) TOW mobility rate decile values (meters/second) - movement to contact

Decile sample size	Organization			
	T-Series		H-Series	
	270		57	
i	Median	D_i	Median	D_i
1	1.59	2.13	1.28	1.81
2	2.53	2.82	2.25	2.63
3	3.14	3.36	3.01	3.34
4	3.61	3.83	3.60	3.90
5	4.04	4.26	4.14	4.38
6	4.52	4.78	4.61	4.88
7	5.03	5.33	5.18	5.48
8	5.68	6.09	5.83	6.21
9	6.58	7.18	6.65	7.28
10	7.99	24.84	8.50	24.72

Table F-13.   Trials 3, 4 (T-, H-Mech) TOW mobility rate decile values (meters/second) - active defense

Decile sample size	Organization			
	T-Series		H-Series	
	68		46	
i	Median	D_i	Median	D_i
1	1.82	2.10	2.01	2.61
2	2.35	2.70	3.08	3.57
3	3.11	3.45	3.94	4.25
4	3.64	3.94	4.55	4.82
5	4.27	4.55	5.16	5.35
6	4.90	5.22	5.67	6.07
7	5.53	5.92	6.35	6.67
8	6.30	6.66	6.92	7.31
9	7.06	7.92	7.75	8.45
10	8.01	16.34	9.21	12.59

Table F-14. Trials 3, 4 (T-, H-Mech) TOW mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	T-Series		H-Series	
	196		96	
i	Median	D_i	Median	D_i
1	1.37	1.79	1.28	1.75
2	2.15	2.43	2.16	2.58
3	2.80	3.12	2.91	3.28
4	3.38	3.64	3.59	3.88
5	3.89	4.11	4.20	4.48
6	4.36	4.56	4.86	5.14
7	4.81	5.06	5.50	5.86
8	5.26	5.55	6.34	6.83
9	5.94	6.44	7.32	8.00
10	7.24	21.61	8.89	21.12

Table F-15. Trials 3, 4 (T-, H-Mech) TOW (Mech) mobility rate decile values (meters/second) - movement to contact

	Organization			
	T-Series		H-Series	
Decile sample size			160	
i	Median	D_i	Median	D_i
1			1.39	1.79
2			2.14	2.47
3			2.76	3.01
4			3.25	3.51
5			3.74	3.96
6			4.21	4.49
7			4.78	5.04
8			5.37	5.69
9			6.18	6.78
10			7.52	21.62

Table F-16. Trials 3, 4 (T-, H-Mech) TOW (Mech) mobility rate decile values (meters/second) - active defense

Decile sample size	Organization			
	T-Series		H-Series	
	15		54	
i	Median	D_i	Median	D_i
1	1.82	2.55	1.85	2.19
2	3.03	3.58	2.59	3.10
3	3.61	4.13	3.41	3.80
4	4.82	5.12	4.21	4.60
5	5.51	5.66	5.00	5.44
6	5.81	6.10	5.67	6.02
7	6.19	7.04	6.42	7.00
8	7.62	7.95	7.48	7.89
9	8.29	8.53	8.40	8.89
10	9.54	12.91	9.51	14.08

Table F-17. Trials 3, 4 (T-, H-Mech) TOW (Mech) mobility rate
decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	T-Series		H-Series	
	29		47	
i	Median	D_i	Median	D_i
1	1.37	1.68	1.12	1.36
2	1.96	2.27	1.56	1.74
3	2.55	2.93	1.92	2.14
4	3.15	3.36	2.32	2.51
5	3.51	3.79	2.76	2.95
6	4.03	4.23	3.19	3.51
7	4.64	4.88	3.95	4.32
8	5.12	5.54	4.80	5.37
9	5.92	6.33	6.27	7.04
10	7.33	9.24	8.12	50.00

Table F-18. Trials 5, 6 (H-, T-Tank) tank mobility rate decile values (meters/second) - movement to contact

Decile sample size	Organization			
	H-Series		T-Series	
			213	
i	Median	D_i	Median	D_i
1			1.41	1.77
2			2.05	2.28
3			2.50	2.66
4			2.83	2.99
5			3.13	3.26
6			3.43	3.59
7			3.77	4.00
8			4.25	4.54
9			4.91	5.30
10			5.99	13.92

Table F-19. Trials 5, 6 (H-, T-Tank) tank mobility rate decile values (meters/second) - active defense

Decile sample size	Organization			
	H-Series		T-Series	
	88		145	
i	Median	D_i	Median	D_i
1	1.12	1.36	1.71	1.94
2	1.55	1.81	2.24	2.58
3	2.09	2.31	2.85	3.11
4	2.61	2.91	3.34	3.56
5	3.15	3.36	3.81	4.06
6	3.61	3.93	4.31	4.62
7	4.18	4.59	4.92	5.19
8	4.99	5.34	5.51	5.92
9	5.72	6.42	6.40	7.21
10	7.24	14.03	8.19	15.77

Table F-20. Trials 5, 6 (H-, T-Tank) tank mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	H-Series		T-Series	
	579		323	
i	Median	D_i	Median	D_i
1	1.30	1.59	1.29	1.55
2	1.88	2.16	1.80	1.99
3	2.46	2.75	2.19	2.36
4	3.02	3.29	2.51	2.65
5	3.56	3.86	2.84	3.02
6	4.18	4.50	3.19	3.35
7	4.87	5.25	3.56	3.77
8	5.61	6.05	4.02	4.30
9	6.59	7.23	4.70	5.24
10	8.29	25.24	6.08	17.17

Table F-21. Trials 5, 6 (H-, T-Tank) TOW mobility rate decile values (meters/second) - movement to contact

Decile sample size	Organization			
	H-Series		T-Series	
			83	
i	Median	D_i	Median	D_i
1			1.42	1.80
2			2.17	2.56
3			2.84	3.10
4			3.32	3.59
5			3.88	4.17
6			4.39	4.58
7			4.80	5.07
8			5.35	5.66
9			6.10	6.61
10			7.45	11.69

Table F-22. Trials 5, 6 (H-, T-Tank) TOW mobility rate decile values (meters/second) - active defense

Decile sample size	Organization			
	H-Series		T-Series	
			54	
i	Median	D_i	Median	D_i
1			1.89	2.12
2			2.43	2.72
3			2.96	3.37
4			3.61	3.86
5			4.16	4.33
6			4.56	4.88
7			5.27	5.62
8			6.03	6.64
9			7.21	7.89
10			9.00	22.83

Table F-23. Trials 5, 6 (H-, T-Tank) TOW mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	H-Series		T-Series	
			136	
i	Median	D_1	Median	D_1
1			1.31	1.57
2			1.81	2.04
3			2.28	2.43
4			2.64	2.84
5			3.02	3.26
6			3.46	3.71
7			3.91	4.21
8			4.49	4.78
9			5.19	5.74
10			7.16	26.48

Table F-24. Trials 5, 6 (H-, T-Tank) TOW (Mech) mobility rate
decile values (meters/second) - active defense

Decile sample size	Organization			
	H-Series		T-Series	
	40			
i	Median	D_i	Median	D_i
1	1.20	1.52		
2	2.01	2.34		
3	2.63	2.91		
4	3.28	3.72		
5	4.03	4.32		
6	4.62	5.05		
7	5.58	6.02		
8	6.46	6.96		
9	7.40	8.11		
10	9.07	15.37		

Table F-25. Trials 5, 6 (H-, T-Tank) TOW (Mech) mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	H-Series		· T-Series	
	114			
i	Median	D_i	Median	D_i
1	1.43	1.80		
2	2.28	2.73		
3	3.12	3.43		
4	3.76	4.06		
5	4.34	4.64		
6	4.96	5.21		
7	5.51	5.90		
8	6.29	6.75		
9	7.43	8.19		
10	9.36	19.07		

Table F-26. Trials 7, 8 (H-, T-Mech) tank mobility rate decile values (meters/second) - movement to contact

Decile sample size	Organization			
	H-Series		T-Series	
	132		116	
i	Median	D_i	Median	D_i
1	1.33	1.62	1.30	1.59
2	1.91	2.14	1.79	1.94
3	2.37	2.61	2.14	2.28
4	2.85	3.06	2.46	2.67
5	3.26	3.50	2.84	3.03
6	3.71	4.02	3.22	3.41
7	4.29	4.58	3.61	3.78
8	4.88	5.19	4.05	4.34
9	5.60	6.40	4.70	5.39
10	7.37	15.52	6.64	15.56

Table F-27. Trials 7, 8 (H-, T-Mech) tank mobility rate decile
values (meters/second) - active defense

Decile sample size	Organization			
	H-Series		T-Series	
	64		60	
i	Median	D_i	Median	D_i
1	1.90	2.36	1.83	2.25
2	2.77	3.19	2.56	2.85
3	3.54	3.82	3.14	3.32
4	4.10	4.48	3.53	3.71
5	4.70	5.05	3.86	4.08
6	5.33	5.63	4.22	4.37
7	5.91	6.22	4.62	4.87
8	6.60	6.86	5.14	5.47
9	7.19	7.64	5.91	6.48
10	8.49	19.96	7.08	26.34

Table F-28. Trials 7, 8 (H-, T-Mech) tank mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	H-Series		T-Series	
	137		171	
i	Median	D_i	Median	D_i
1	1.41	1.79	1.46	1.86
2	2.18	2.54	2.24	2.53
3	2.86	3.15	2.75	2.94
4	3.44	3.72	3.13	3.29
5	4.07	4.40	3.46	3.69
6	4.74	5.09	3.99	4.34
7	5.51	5.90	4.75	5.17
8	6.32	6.75	5.63	6.12
9	7.20	7.72	6.78	7.37
10	8.53	11.87	8.52	24.24

Table F-29. Trials 7, 8 (H-, T-Mech) TOW mobility rate decile values (meters/second) - movement to contact

	Organization			
	H-Series		T-Series	
Decile sample size			44	
i	Median	D_i	Median	D_i
1			1.42	1.72
2			2.13	2.50
3			2.85	3.16
4			3.50	4.06
5			4.33	4.65
6			4.93	5.24
7			5.60	6.06
8			6.51	6.82
9			7.36	8.14
10			9.31	19.88

Table F-30. Trials 7, 8 (H-, T-Mech) TOW mobility rate decile
values (meters/second) - active defense

Decile	Organization			
	H-Series		T-Series	
sample size	44		42	
i	Median	D_i	Median	D_i
1	1.93	2.22	1.94	2.21
2	2.80	3.02	2.46	2.77
3	3.35	3.82	3.00	3.16
4	3.97	4.32	3.47	3.67
5	4.62	4.91	3.94	4.15
6	5.16	5.44	4.43	4.72
7	5.65	5.90	5.05	5.60
8	6.27	6.64	6.09	6.53
9	7.06	7.83	7.23	7.71
10	8.91	18.03	8.35	19.24

Table F-31. Trials 7, 8 (H-, T-Mech) TOW mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	H-Series		T-Series	
	66		99	
i	Median	D_i	Median	D_i
1	1.40	1.83	1.35	1.67
2	2.45	2.81	2.05	2.40
3	3.20	3.50	2.71	2.99
4	3.83	4.18	3.18	3.46
5	4.47	4.88	3.73	4.00
6	5.19	5.56	4.26	4.60
7	6.07	6.53	4.88	5.29
8	6.97	7.63	5.67	6.05
9	7.97	8.45	6.66	7.07
10	9.13	16.02	8.05	12.78

Table F-32. Trials 7, 8 (H-, T-Mech) TOW (Mech) mobility rate decile values (meters/second) - movement to contact

Decile sample size	Organization			
	H-Series		T-Series	
	155			
i	Median	D_i	Median	D_i
1	1.36	1.74		
2	2.05	2.29		
3	2.65	2.96		
4	3.22	3.46		
5	3.74	4.01		
6	4.29	4.52		
7	4.75	5.01		
8	5.37	5.69		
9	6.18	6.80		
10	7.74	17.18		

Table F-33. Trials 7, 8 (H-, T-Mech) TOW (Mech) mobility rate decile values (meters/second) - deliberate attack

Decile sample size	Organization			
	H-Series		T-Series	
	174			
i	Median	D_i	Median	D_i
1	1.42	1.78		
2	2.20	2.66		
3	3.07	3.44		
4	3.81	4.17		
5	4.46	4.81		
6	5.22	5.54		
7	5.95	6.26		
8	6.66	7.15		
9	7.59	8.10		
10	8.87	12.88		

Table F-34. Trials 7, 8 (H-, T-Mech) TOW (Mech) mobility rate
decile values (meters/second) - active defense

Decile sample size	Organization			
	H-Series		T-Series	
	125			
i	Median	D_i	Median	D_i
1	1.93	2.32		
2	2.78	3.17		
3	3.54	3.91		
4	4.19	4.60		
5	4.97	5.39		
6	5.75	6.14		
7	6.47	6.91		
8	6.91	7.62		
9	8.10	8.66		
10	9.48	13.89		

APPENDIX G

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